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A comparative study of priorities for pre-college marine education objectives in Virginia

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A COMPARATIVE STUDY OF PRIORITIES FOR PRE-COLLEGE MARINE EDUCATION OBJECTIVES IN VIRGINIA

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APPROVAL SHEET

This dissertation is submitted in partial fulfillment of

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LIST OF TABLES

"...the chief consideration to which all others are to be subordinated, in the opinion of your committee, is this requirement of the civilization into which the child is born, as determining not only what he shall study in school, but what habits and customs he shall be taught in the family before the school age arrives..."

Report of the Committee of Fifteen on Elementary Education

(Harris, 1895)

ABSTRACT

A modified three round Delphi survey was used to determine marine oriented knoweledge, skill, and attitude objectives for pre-college programs in Virginia. Respondents from five marine employment sub-fields, and one group of lay people, were included. Thirty-eight knowledge, 29 skill, and 73 attitude objectives were selected as high priority.

Marine science respondents favored items dealing with food webs; the effect of large bodies of water on weather and climate; the power and inevitability of hurricanes and littoral drift; ecological balance; the balance between resource development and habitat preservation between aesthetics and economics, and between technology and the environment; the willingness to restrict development; the need for resource management; and the need for the enforcement of reasonable regulations.

The respondents other than those in the marine science group more highly favored objectives concerned with water pollution; the effects of a "dead" Chesapeake Bay; the impact of sewage discharges and chemicals; and administering first aid for burns, shock, and drowning.

In terms of broad categories, marine science respondents ranked the following as lower priority than did the other groups: (1) the influence of water on our history, (2) economics (knowledge), (3) defense (knowledge), and (4) safety (skills).

A COMPARATIVE STUDY

OF

PRIORITIES FOR PRE-COLLEGE MARINE EDUCATION

OBJECTIVES IN VIRGINIA

INTRODUCTION

Origin of the Study

In 1977, Dr. Joseph Exline asked that the Marine Education staff of the Virginia Institute of Marine Science (VIMS) provide him a list of educational objectives for use in evaluating and developing the marine science being taught in Virginia high schools. As part of his work with the Science Service of the Virginia Department of Education, Dr. Exline had compiled a list of such objectives based on his own judgement and on publications of scientists from VIMS (Appendix B). He wished that this list be confirmed, or a new more satisfactory one be provided in its place.

A check of previous attempts to provide similar objectives (Appendices A and B) revealed that little attention had been paid to the opinions of any but marine scientists and educators. In spite of a resurgence of public demands for relevance in what is taught in our schools, in spite of the long standing claim by the Committee of Fifteen that a child's civilization should be the chief determinant of his or her education (Harris, 1895), marine science objectives had been determined instead by a remarkably small number of marine experts with a very specialized knowledge of the sea and its impact on our society.

This study was undertaken to determine whether the opinions of marine scientists and educators in Virginia are significantly different from the opinions of others who have gained marine expertise

by working in marine related jobs. It was also designed to insure that any marine education objectives provided the Department of Education have a broader base of support than that enjoyed by similar objectives determined in earlier studies.

As Goodwin and Schaadt (1978) pointed out, it is necessary "to decide which of the myriad of things about the world of water are priorities and should be learned by people everywhere to achieve the goals of basic understanding of and sensitivity to the world of water."

This study used a modified Delphi survey to solicit objectives from citizens working in each of the major marine-related fields as determined by Mackin and Anderson (1976), and from interested citizens; and to determine which of those objectives were rated by these individuals as having the highest priority for Virginia's elementary and secondary schools.

Definitions of Marine Education

Goodwin (1976) defined marine education as "that integral part of education which teaches about the world of water." After extensive consultation with other marine educators, Goodwin (1977a) concluded that: "Marine education is that integral part of the total educational process which produces a marine-literate person who understands the role of the marine environment in human affairs and the impact of society on the marine environment."

This definition was unacceptable to many of the educators who criticized Goodwin's work during an intensive study involving 26 workshops in 18 states. They felt that since freshwater ecosystems were a part of the effort Goodwin was delineating, this should be clearly indicated in any definition. The final version (Goodwin and Schaadt, 1978) therefore read: "Marine and aquatic education is that part of the total education process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments."

This definition has been widely accepted (Ludwigson, 1978a; Picker, 1980), although the word "aquatic" is usually dropped. The shorter term "marine education" has been used at least since the National Marine Education Conference held in 1974 at the University of Rhode Island (Shafer, 1974). It has been adopted by the National Marine Education Association, several regional associations, and CURRENT, the Journal of Marine Education, an established national publication. In addition, "aquatic" refers to marine as well as fresh waters, making the term "marine and aquatic" redundant.

Fortner (1978) defined marine education as "that part of the educational process, formal and informal, which imparts information about the relationship of the global sea to all world systems and the impact of society upon that sea."

"Marine education" as used in this study is meant to include all that Goodwin and Schaadt (1978) included in "marine and aquatic education", but with an emphasis on pre-college formal programs dealing with marine and estuarine environments. This usage is intended to be more inclusive than that used by Fortner (1978), since it includes the estuaries and fresh water which are so important to Virginians.

Origins and Development of Marine Education

Although the organized marine education movement in the United States is relatively recent in origin (Schweitzer, 1974; Siegel, 1976), its roots are in the earliest study of the oceans, known as oceanography or marine science (Yasso, 1965). These roots are diverse and diffuse, since the national meetings which began in the 1960's gave marine education its first cohesive identity (Linsky, 1968; Brisby, 1968; and Keith, 1966).

The earliest recorded studies of marine subjects predate even those of Aristole, whom some consider to be the first marine biologist. Xenophanes, for example, discovered marine fossils in the mountains of southern Italy about 500 years before Christ, "and concluded that the mountains must have been underwater at one time" (Idyll, 1969).

In some ways these early philosophers, and all others since who have studied the sea, were oceanographers. According to Idyll (1969), however, "The birth of oceanography as a science can be pinpointed

with remarkable accuracy. It occurred on January 3, 1873, when scientists aboard HMS Challenger began collecting data, making five soundings and three dredge hauls west of Lisbon." Thus began the first worldwide, comprehensive oceanographic expedition.

The origin of "marine education," as defined by Goodwin and Schaadt (1978), is less well documented than that of oceanography. It is clear, however, that the modern marine education movement in the United States began in the 1960's as pre-college marine science education. It was not until the 1974 conference at the University of Rhode Island that "science" was deliberately deleted from the term. Marine topics in pre-college science courses continue as an important part of the effort to this day, however.

One pioneer program which had much in common with today's marine education efforts was that of the Virginia Fisheries Laboratory, which later became the Virginia Institute of Marine Science (VIMS). According to Newcombe (1946), the Laboratory began in the 1940's to develop "a broad educational program in the field of marine biology and conservation" aimed at pre-college students. The purpose of this program was "to disseminate knowledge of the Tidewater fishery resources, and to encourage the development of these resources through a better informed public opinion, which will support fishery research, constructive legislation, and bring about a closer voluntary adherence to sound conservation practices."

Another forerunner of the modern marine education movement developed from the summer marine biology courses begun at Grand Isle, Louisiana, in 1931. According to Schweitzer (1978), Dr. Harry Bennet taught nine week courses to majors in education, zoology and geology. From 1945 to 1955, about five education majors or teachers participated each summer.

Dr. Bennet also taught between 15 and 30 high school teachers or students in National Science Foundation sponsored summer programs convened each year from 1956 to 1968 at the Gulf Coast Research Laboratory in Ocean Springs, Mississippi. He taught at least two more National Science Foundation Institutes at Louisiana State University during the early 1970's (Schweitzer, 1978).

Schweitzer (1974) concluded that the first pre-college "academic programs in marine science appeared about 15 years ago," a time when the pioneering efforts cited above, and others, had actually been in existence for years. Schweitzer cited other early programs in southern New England, Florida, and California. He went on to say that "later they appeared in other states including those of the Pacific Northwest, Texas, and New York. As might seem natural, most of these programs were developed in the coastal states. A few, however, appeared in inland states that included Missouri, Colorado, Wisconsin, and Minnesota."

In a study for the New York State Marine Education Association, Siegel (1976) found that although marine education was in many ways in

its pioneer stages, many programs had been in existence around the country 20 years prior to his survey. Most secondary programs in New York, however, were only a few years old.

Public interest in marine science did increase dramatically during the late 1960's and received even more emphasis as the result of the environmental movement (Ludwigson, 1978b). This interest was not immediately translated into support of pre-college marine education efforts, but "focused on production of specialist manpower" (Goodwin, 1978). In fact, few Federal agencies supported public education on the aquatic environment in general (Shafer, 1978).

Some Federal programs did provide important support for developing marine education programs at all levels, however. The National Science Foundation sponsored summer institutes for teachers and/or students not only in Louisiana, but at Bowdoin College, Suffolk University, VIMS, and the University of Washington. The Title III program of the U.S. Office of Education sponsored other important pioneering efforts, such as the Orange County (California) Marine Science Floating Laboratory program and the Carteret County (North Carolina) Marine Science Project (Schweitzer, 1974).

Early programs were mostly related to marine biology (Schweitzer, 1974), but more recently the marine education movement has become increasingly humanistic and interdisciplinary. Will Hon was an early advocate of this trend. In the late 1960's he used Title III money to produce materials that were widely used by teachers in the eastern

United States (Schweitzer, 1974), and represent a pioneering marine education effort. In his introduction to these materials, Hon (1969) made his case for the importance of the affective domain:

> It may well be, as Rachel Carson mused, that it is not as important to know as to feel. The Carteret Marine Science Project may create few research biologists, but it can scarcely fail to make our clerks, salesmen, and firemen of the future acutely aware of the complex marriage of land and sea. The intertwining of these two worlds is fraught with the greatest potentials and the most grievous of problems.

Goodwin (1976b) felt that marine education became an element of national policy with the advent of the Sea Grant Program in 1966. Robert Abel, the first head of Sea Grant, was initially interested primarily in funding engineering and technical training. He recognized, however, a national concern for the motivation of high school children (Abel, 1967), and felt that "to delay the awakening of a student's interest until college is to wait too long. Even the first grade is not too early to begin stimulating a youngster's imagination with the exciting phenomena of the sea" (Abel and Lindquist, 1965).

Sea Grant has since given funds to colleges and universities on all coasts of the United States (including the Great Lakes) for programs which have "provided consultation, conducted teacher workshops, and published teaching aids and curricular materials that

have benefited the growing community of pre-college marine science teachers" (Schweitzer, 1974).

Current Status of Marine Education in the United States

On April 21, 1976, Harold Goodwin, a former Associate Director of the Sea Grant Program, convened a Sea Grant Education Workshop in Williamsburg, Virginia. Twenty-five educators, from all the coasts of the United States, met to examine Sea Grant's role in relation to: "(1) national needs for environmental education; (2) national needs for marine specialist education and training; (3) the needs of the Sea Grant Program itself; (4) other agency missions and programs; (5) the abilities and limitations of the Sea Grant network of institutions and programs; and (6) present, pending, and/or necessary Sea Grant legislation" (Goodwin and Goodwin, 1976).

At this meeting, Logan Sallada of the U.S. Office of Education suggested that marine education would never receive significant federal support without a concise definition of what it is all about and why it is important. As a result of these remarks, Harold Goodwin began his project at the University of Delaware which developed a document to provide that information: The Need for Marine and Aquatic Education (Goodwin and Schaadt, 1978), which is quoted at the beginning of this chapter.

Another effort which began at the Williamsburg conference resulted in the "Memorandum of Agreement between the United States Office of Education and the National Ocean and Atmospheric

Administration," signed on August 25, 1977. This agreement was designed "to encourage the development of an integrated and coordinated national, state, regional, and local marine environment education program" (Goodwin and Schaadt, 1978).

The Sea Grant appropriation for the 1977 fiscal year provided for a $4,000,000 increase for marine education and the marine advisory services. Ned Ostenso, the new Sea Grant Director, responded by stating that his office strongly endorsed marine topics as "an important element of a pre-college educational program", and should "contribute to improving the marine content of pre-college education through cooperation with and support of local, regional, state and national organizations and agencies that foster and are responsible for pre-college education" (Ostenso, 1977).

As a result, Sea Grant is emphasizing curriculum development, teacher training, and cooperative agreements, such as the one with the Office of Education (Ludwigson, 1978a). Such efforts have an indirect impact on far more people than those who receive funds directly. The 28 pre-college marine education projects funded by Sea Grant during 1977 were spread through at least 17 states, and many made good use of this "multiplier effect."

Goodwin (1978) summed up the current status of the marine education movement in the United States in a brief review for "Sea Technology" magazine:

> After a decade during which marine education has focused on production of specialist manpower [scientists and technicians] activities to teach everyone about the world of water are taking on the dimensions of a spring tide. Nearly every coastal state and several inland states have programs in kindergarten to 12th grade marine education, adult education, and general public education through the mass media.
>
> The impact of the new look in marine education already is felt in some coastal states, but the main thrust is not yet organized or underway. Most marine educators believe it is essential to include marine education as an integral part of general education, building the oceans in all their aspects into the basic curriculum structure of the sciences, humanities, and social sciences.
>
> Specialized courses should be developed where needed, primarily on the coasts, but knowledge about and sensitivity to the national interests in the oceans, including our economic, social, environmental, and defense dependence, should be part of the equipment of every person. It's a task for the long haul, but the basic structure is building rapidly. The marine education goal for 1978 should be to keep the momentum and encourage the spread toward our inland states.

Conclusions

Since the mid-1960's, a coherent marine education movement has developed from diffuse and uncoordinated efforts related primarily to biological oceanography. Today's marine educators have their own professional organization and journal, and have succeeded in securing funding for a variety of special programs across the nation. Interest and momentum continue to build.

Marine education remains as broad as the world of water, both fresh and salt. The modern movement has broadened still further to

include the social sciences and humanities, but retains a strong relationship to oceanography and oceanographers.

This study was undertaken in an effort to provide priority objectives for pre-college marine education which are based on a broad opinion sample, in keeping with the broad nature of the field, and which are detailed and precise, in recognition of the practical needs of curriculum designers. A review of the literature indicated that such objectives had not yet been developed for marine education.

REVIEW OF RELEVANT LITERATURE

Introduction

Gardner (1979), in her assessment of the 10 most important trends in science education, concluded that research in needs assessment is assuming new importance, and that emphasis on theory and "traditional rules of research design and statistical analyses are partly giving way to the recognition that developmental or action research - particularly regarding curriculum development and implementation - is also important."

While such an assessment was encouraging support for this needs assessment for marine education, a review of the literature revealed that a confusing variety of sources have been used in such studies of educational goals and objectives. These include the interests of students, final examinations, textbooks, the media, everyday activities, expert opinion (including parents), job analyses, consumer needs, social problems, and recreational activities (Hurd, 1970).

Opinions vary considerably as to which of these sources will produce the most appropriate, relevant, and useful objectives, although there seem to be two general approaches concerning who should decide: those who feel that the lay public should be involved, and those who argue that national groups of scholars should make these decisions (Ammons, 1969). The opinions of both groups were included in this study.

The Need for a Broad Opinion Sample

Bobbitt (1918) felt that establishing educational objectives

> requires only that one go out into the world of affairs and discover the particulars of which these affairs consist. These will show the abilities, attitudes, habits, appreciations, and forms of knowledge that men need. These will be the objectives of the curriculum. They will be numerous, definite and particularized. The curriculum will then be that series of experiences which children and youth must have by way of attaining those objectives.

A number of investigators have agreed with this use of a broad sample of opinion to develop detailed and specific objectives, the approach used in this study. Van Til (1954), for example, felt that all those who are affected by a curriculum should participate in its improvement. Taba (1962) seemed to agree when she wrote that the goals and demands of society should "determine what knowledge is most worthwhile, which skills should be mastered, which values are relevant." The social and cultural realities of the times should, according to Taba, select "from the scientifically valid and fundamental knowledge that which is also significant."

In his review of mid-century trends in science education, Hurd (1953) also sided with those favoring a broad source of opinion. He concluded that the role of science in human affairs and its implications for contemporary society should be the prime factors in the selection of content.

Anderson (1965) listed the "community" among the most powerful of curriculum makers, and felt that "The community has a right and an obligation to participate in defining the school's program." He went on to say that lay people who are broadly representative of the community should be included in curriculum studies, and that written questionnaires can be helpful in determining whether a particularly vocal group accurately represents community opinion.

A number of other authors have also supported the idea that the community should be consulted on educational issues. White (1978) wrote that the determination of curriculum objectives is a political as well as an educational decision. Harbeck (1978) suggested the use of a community survey to show student needs, rather than reliance on textbook programs. The Competency Based Curriculum project which he described is part of one of the major movements in modern education.

While there is good support for the need to consult the community in the development of educational objectives, Gardner (1979) has concluded that "we still lack the skill and instrumentation to find definitive answers to such things as what types of new science curricula are needed to advance science and technology and serve society's needs for the near future."

Charters (1923) has further suggested that in such an "absence of absolute measurement, consensus determines superiority." One of the modern tools most often suggested for determining consensus is the

Delphi Technique. A review of the literature on Delphi was therefore conducted to determine its suitability for use in this study.

The Delphi Technique

The Delphi Technique is "a carefully designed program of sequential individual interrogations (best conducted by questionnaires) interspersed with information and opinion feedback" (Helmer and Rescher, 1959). Originally developed by the Rand Corporation to obtain better consensus about future events from groups of experts (Uhl, 1971), Delphi has since been used to establish educational goals in a number of studies (Anderson, 1970; Cyphert and Gant, 1971; Judd, 1970; Norton, 1970; and Uhl, 1971).

By eliminating face-to-face discussion and insuring the anonymity of respondents, the use of the Delphi technique can save money, encourage individual thought, and generally improve the likelihood that any changes in individual opinions were the result of judgement, not the influence of opinion leaders (Weaver, 1971). As Judd (1970) put it: "Delphi permits gaining the individual views of all while not submerging the individual views of anyone." Weaver (1971) pointed out that Delphi might aid in determining priorities, and Pill (1970) concluded that "Delphi is as good as any technique for combining expert opinion."

Group discussions, although they are a more traditional method for combining individual opinion, have been found to be too subject to inordinate influence by dominant individuals, excessive, irrelevant or

biasing discussion, and group pressure which distorts individual judgements (Uhl, 1971). Uhl (1971) also concluded that Delphi permits independent thought, and helps its participants to form their opinions.

Huckefeldt and Judd (1975) provided an overview of the uses of Delphi in higher education, and methods for use in large-scale Delphi studies (generally, those using 100 or more respondents). They also reported that Norman Dalkey, one of the originators of the technique, felt that useful as it had been in forecasting future developments, it would also be helpful in developing and assessing goals and objectives.

Weaver (1971) also encouraged the use of Delphi for determining educational objectives. Although he questioned the significance of the convergence of opinion achieved by the feedback of results in Delphi, his review of the method led him to the conclusion that its more promising educational application is as "a planning tool which may aid in probing priorities."

The general procedure for the Delphi technique has been outlined by Uhl (1971) as follows:

1. The participants are asked to list their opinions on a specific topic.
2. The participants are then asked to evaluate the total list by a criterion, such as importance, chance of success, etc.
3. Each participant receives the list again, with a summary of responses to each item and, if in the minority, is

asked to revise his opinion or indicate his reason for remaining in the minority.

4. Each participant again receives the list, an updated summary, minority opinions, and a final chance to revise his opinions."

Although Delphi has not been used for a study of marine education goals or objectives, several of the studies mentioned above, which were designed to determine goals and objectives for other educational programs and for curriculum planning, are of interest. Their methods may be useful for a marine education study, even though their results are not.

Cyphert and Gant (1971) included 421 respondents in their attempt to gain consensus on goals for the University of Virginia School of Education in the next decade. They felt that "besides giving the satisfaction of planning the future with the assistance of data, this survey made the influential persons in the Commonwealth aware of the school's existence and gave them a vested interest in its future accomplishments."

Uhl (1971) used a modified Delphi survey to determine perceived existing goals for institutions of higher learning, as well as "beliefs about what the institution goals ought to be." Uhl's study, like many of the studies of marine education goals and objectives cited above, included a preliminary goals inventory which was initially presented to the respondents. This, in effect, eliminated step one of the usual Delphi procedure, and may have biased his results since no provision was made for the respondents to add or

delete goals. They were asked only to indicate the relative importance of the goals supplied by Uhl. Uhl eliminated the first step essentially to save time.

Cyphert and Gant (1971), in developing goals for the School of Education of the University of Virginia, found that 99% of their respondents' changes in opinion occurred at step three, so that they "seriously question the need for going beyond" this step.

While this review of the literature revealed that the Delphi could be useful in a study of priorities for marine education objectives, it also uncovered a number of concerns which influenced its use. Using only the objectives submitted by the respondents, and insuring their anonomity, was seen as essential if the maximum attention was to be paid the opinions of the respondents. Conversely, Cyphert and Gant's (1971) study indicated that little was to be gained from the expense of going beyond step three (third Delphi questionnaire). Consequently only three rounds of the Delphi were used in this study.

The Goals and Objectives of Marine Education

It seems clear that the educators cited in the previous section are calling for a consensus which includes the general public, as well as educational and scientific experts. Charters (1923), however, felt that in some cases, "expert consensus" is more reliable than "common opinion". In this study, therefore, the opinions of experts were also

sampled in order to determine how much and in what ways they might differ from those of the general public.

A number of workers have already compiled lists of goals and objectives for marine education (Appendix A and B). Their work is reviewed here. Textbooks, usually written by educators and/or marine scientists, and the opinions of marine educators and/or marine scientists were the sole sources upon which these lists were based, except for the one developed by the Hawaii Marine Education Council (1975). Input from the general public, or even from experts in marine-related jobs (other than educators and scientists), was lacking in the other studies reviewed.

Not only have most of these studies been based on a narrow sample of opinion, they have often been "derived under the undue influence of certain psychological factors, such as specious persuasion by the group member with the greatest supposed authority or even the loudest voice, an unwillingness to abandon publicly expressed opinions, and the bandwagon effect of majority opinion" (Cyphert and Gant, 1971).

The Hawaii Marine Education Council (1975, Appendix B) study drew on the broad opinions of students, teachers, administrators, educational associations, university faculty, state and county employees, as well as industry and labor. Their objectives were developed through a series of conferences. Their conclusions were

therefore subject to the deficiences listed by Cyphert and Gant (1971) above, and by Uhl (1971), cited in the previous section.

"A Conceptual Scheme for Studies of Aquatic Environments" (Geens and Stegner, Appendix B) consists of a series of statements which have been widely distributed and presented as encompassing everything of importance to marine education. While Stegner (1978) described the process used to develop this scheme as "off the top of Maura Geens' and my heads", he did feel that scrutiny by marine educators has lent some support to the validity of their work as the basis for the construction of marine curricula.

Teller and Awkerman (1971) surveyed 161 practicing oceanographers, asking them to rank order 40 questions on the basis of academic content and relevance to coastal laymen. The questions were compiled originally by the project staff. Two-thirds of the oceanographers polled gave 15 of the questions (Appendix B) high marks in both areas, but none of these scientists added any new questions of their own. Whether the final results were most representative of the respondents' or the investigators' opinions is therefore in doubt. It seems likely that the investigators introduced their own biases.

Another study which has not provided for any respondent input other than rank ordering is that of Pike (1977). She conducted a field study designed to help develop an interdisciplinary program of marine studies for Rogers High School in Newport, Rhode Island, and attempted to identify the goals of other marine education programs.

She sent out a list of "goals compiled from various sources" (Appendix A) and asked that her respondents "indicate what you think their priorities would be in the program described above by ranking them from numbers 1-16, No. 1 being the highest rank."

Studies such as those of Teller and Awkerman (1971) and Pike (1977), biased the response of their advisors by providing them with a list of objectives compiled by the researchers. These studies did not include a provision for including objectives originating from respondents, even if they were offered.

Shafer (1972) compiled a list of nine major points based on his own experience and opinion (Appendix B). Similarly, MacLean (1976) claimed only that his "curriculum clusters represent the current scope of marine education as I see it, divorced from the more classical approach of dividing classroom instruction into physical, chemical, and biological worlds." MacLean (1967A) provided a list of 27 curriculum clusters (Appendix B).

Raymond (1976) looked at a different type of marine education needs, those which an education group, such as the National Marine Education Association, might support. He was exploring various ways of achieving the objectives of marine education, while we are concerned here with what those objectives should be in the first place. The method he used to determine these needs is of interest, however, since it could be considered for use in a study like the present one.

Raymond (1976) used a technique developed by William Reeder, Department of Rural Sociology, Cornell University. Raymond used a panel of six marine educators who were asked to list "those needs of marine education which an association could help with." Panel members developed their individual lists for about ten minutes and were then "directed into groups of four to share and expand upon their lists. After approximately 20 minutes, the group sessions were terminated and the 'needs' were tabulated on newsprint. Two persons were solicited to record these needs, thereby speeding the process. Each group of four was sequentially asked for one or two needs, until after going around the room several times all were recorded."

The marine education needs identified by Raymond (1976) were organized into three categories: a) exchange and communication, b) educational materials, and c) program support. The individual needs listed under these categories were ranked according to the number of panel members who agreed that the need was one of the most important. As Raymond (1976) pointed out, this ranking "is not a consensus and not an identification of the most important need." Therefore, if this method were used to develop objectives for marine education, it would not provide consensus nor would it indicate which objectives were the most or least important.

The development of the broad goals outlined by Goodwin and Schaadt (1978) was first proposed at a Sea Grant Marine Education Workshop in April of 1976 at the Virginia Institute of Marine Science, and was discussed at 26 additional workshops in 18 states. Those

attending these "structured bull sessions" (Goodwin, 1976A) were almost all closely associated with marine education either as teachers, administrators, or supervisors.

An even less structured group discussion was used by Astro et al. (1977) in reacting to and adding to the goals stated in Goodwin and Schaadt (1978). Little time was provided for the development of ideas, and none for feedback. Although general educational awareness goals were listed (Appendix A), the panel suggested only that specific objectives could be written using a framework based on the cognitive, affective and psycho-motor domains. They felt that "objectives would be diversified according to needs, regions, population, time allotment, resources," and other factors.

The literature review revealed that although many educators agree that "numerous, definite and particularized" (Bobbitt, 1918) educational objectives should be developed from a broad consensus, including lay as well as expert opinion, no such consensus has been sought for the development of marine education objectives. Most studies have relied on the opinion of the authors, or other marine scientists and educators. All of the objectives determined in these studies were subject to the bias imposed either by the use of a list prepared by the investigator, or by the use of the conference method.

Sources of Marine Expertise

Delphi studies were designed for use with individuals who are expert in the area under study (Uhl, 1971). Marine education studies in the past have drawn largely on two types of experts: educators and scientists. For this study, the opinions of those Virginians who have gained their marine expertise on the job in marine-related careers were sampled as an additional and broader source of expertise. The use of this broader opinion sample should result in a more representative assessment of the needs of the "world of affairs" referred to by Bobbitt (1918) and others cited in the first section of this chapter.

The identification of these marine workers was based on the work of Mackin and Anderson (1976), who reported on the results of a national study of marine-related manpower. In order to define a marine career cluster for the U. S. Office of Education, investigators used three main documents to identify marine-related occupations: the Dictionary of Occupational Titles (Bureau of Employment Security - Manpower Administration, 1965), the Occupational Outlook Handbook (Bureau of Labor Statistics, 1974), and the U. S. Office of Education's Vocational Education and Occupations (Office of Education, 1969).

Since marine careers were scattered among the 35,000 occupational titles listed in these publications, "an appropriate framework was created and the available data translated into marine-oriented

information" (Mackin and Anderson, 1976). This framework was used as the basis for the selection of marine workers whose opinions were sampled.

The framework described by Mackin and Anderson (1976) was composed of "five major marine employment sub-fields." These sub-fields were used as a basis for selection of Delphi respondents who could be considered as experts because of knowledge, skills, and attitudes gained "on-the-job" in marine-related careers. These five sub-fields are:

1. Marine recreation (including aquaria and museums, boat building, marinas, and sport fishing).
2. Marine science (including advisory services, education and training, regulatory and environmental, and research and development).
3. Marine resources (including aquaculture, commercial fishing, mining and petroleum, and seafood processing).
4. Marine technology (marine construction, waterway and ocean engineering, and shipbuilding).
5. Marine operations (including merchant marine, inland operations, port and harbor, and offshore support).

Although fishermen or boat builders may not enjoy the benefits of expertise gained through years of advanced formal education, they have learned a great deal about the marine environment, developed strong attitudes towards it, and have specialized marine knowledge and

skills. This study was designed to determine which aspects of this knowledge, and which skills and attitudes, these groups consider most important, and how the opinions of these groups differ from each other and from those of Virginians not employed in marine-related fields.

Conclusions

A review of the literature indicated that a number of educational authorities have supported the idea that educational objectives should be based on both expert and lay opinion. Although a number of studies have produced lists of objectives for marine education, only one was based on the opinions of anyone but marine scientists and educators.

All previous studies of marine education objectives either used lists of objectives prepared by the investigators, or were the products of conferences. Both these methods have been criticized for excessive bias by supporters of the Delphi technique. The Delphi can be used to organize the opinions of large numbers of respondents without providing them with pre-prepared lists or bringing them together physically.

DESIGN

Introduction

A modified Delphi survey was used to sample opinions of workers in marine-related fields, and the lay public, about priorities for marine education. Three rounds of questionnaires went to Virginia representatives of all five of the marine employment sub-fields (marine recreation, marine science, marine resources, marine technology, and marine operations) delineated by Mackin and Anderson (1976), as well as lay people. They were asked what marine-oriented knowledge, skills, and attitudes a student in Virginia should possess by the time he or she graduates from high school.

The Survey

The Delphi technique was designed to collect the opinions of respondents through a survey which excludes the investigator's bias by obtaining the objectives directly from the respondents, and eliminates persuasion from other respondents by never bringing the respondents together in a conference. In a classic Delphi survey, however, respondents can influence each other's opinions since feedback on the results of the previous questionnaire is provided in each subsequent questionnaire. Respondents are asked to reconsider their opinions in the light of the views of their fellow respondents, and defend any position contrary to the majority (Rasp, 1973).

This procedure has raised questions concerning "the significance of 'convergence' of opinion under the conditions imposed by Delphi. The observation that people tend to shift their estimates toward a group norm under conditions of iteration is a consistent and sound observation on the basis of several controlled experiments with Delphi" (Weaver, 1971).

As Cyphert and Gant (1971) showed, however, "the technique can be used to mold opinion as well as to collect it," so that the validity of the final result can be called into question, particularly if the feedback to the respondents is inaccurate. Cyphert and Gant (1971), for example, were able to raise the ranking of an item simply by falsely reporting that the item had been highly ranked on the previous questionnaire. Since the present study was concerned more with differences between groups than with consensus, the Delphi survey procedure was modified and respondents were never asked to change their ratings in light of majority opinion.

Following a classical Delphi round one questionnaire, in which respondents supplied objectives in their own words, six separate questionnaires were prepared for each of the sub-fields of respondents. In round two, respondents in each sub-field saw only the objectives supplied by the others in their sub-field. Only objectives ranked as high priority in at least one sub-field were included in the consolidated round three questionnaire, which was sent to the respondents in all six sub-fields.

Selection of Respondents

Only people currently living in Virginia were selected as respondents. This was important both because of the need to keep costs down and because the needs of different parts of the country may not be the same. A national study would not only be more costly, but might encounter difficulties in consolidating so diverse an opinion sample.

Lists of potential respondents were obtained from computerized mailing lists maintained by Sea Grant Marine Advisory Services at the Virginia Institute of Marine Science, from a survey of marine-oriented employment conducted in Virginia by Kenneth Stibolt of Anne Arundel Community College, Maryland, from the Virginia section of the 1978 Marine Directory (marine operations), from the Hampton Roads Maritime Directory issued April 1, 1979, and from personal contact with the Newport News Shipbuilding and Drydock Company.

In four of the six sub-fields, thousands of addresses were available. Because of cost, mailings to these groups were held to 300 each, selected at random from the address lists. Only 216 addresses were found for Virginians working in marine technology, and 163 for those in maritime operations. A solicitation letter, explanation of the study, and postage paid response card (Appendix C) were sent to all the addressees obtained in these latter two groups, for a total of 1579 mailings (Table 1).

Mailings for all three rounds went to all those who returned the postcard agreeing to participate, whether or not they responded in any particular round.

Round I: Development of Objectives

There is a "Delphi tradition [which] calls for panel correspondents to have a substantially free choice in the nature of their response to the relatively unstructured questions that make up this round" (Huckfeldt and Judd, 1975).

In spite of this tradition, some investigators have eliminated the first round by providing a list of their own design for response from their panels (Uhl, 1971). This was not considered appropriate in this study, since a major goal was the determination of the opinions of various groups, with as little imposition of investigator bias as possible. This study used only objectives submitted by the respondents. In some cases these were reworded for grammatical reasons or in order to combine objectives which differed in wording but not meaning. In no case was an objective deleted because the investigator disagreed with it or felt it was incorrect.

Respondents to Round I were asked simply to list the knowledge, skills, and attitudes which they feel Virginia high school graduates should possess concerning the marine environment, including its ocean areas, estuaries, and rivers. The first questionnaire therefore contained no objectives, but asked the respondents to write their own (Appendix D).

Round I objectives were carefully edited in an attempt to insure that the essential elements of all proposed objectives were retained, while similar objectives with different wordings were combined. The importance of this "content analysis" was stressed by Huckfeldt and Judd (1975), who used a five person team of communications specialists. In this study, editing was done by the investigator, and reviewed by the VIMS Marine Education Staff, the Marine Advisory Specialists for fisheries and marine recreation, and other advisors.

Responses were compiled, copied, and the copies cut into individual objectives. The objectives submitted by each sub-field (marine recreation, marine science, etc.) were treated separately, and the groupings according to knowledge, skills, and attitudes were maintained. The responses from a random sample of lay people on the Marine Advisory Service mailing list was also treated separately. The investigator then examined the objectives, placing objectives which appeared similar together. Each group of similar objectives was then replaced by a simple, concise, and easily understood objective wherever this was possible.

Objectives which were grouped together included such examples as:

1. "General water safety - etc. swim, handle small boats (docking speed, etc.)."

2. "Water and boating safety."

These objectives, which were submitted by respondents, were edited into:

"Practice water safety" (Appendix D, Third Round Consolidated Questionnaire, Objective II. F. 36).

The concerns over boating safety were incorporated in other objectives since a rule in all editing was "that nothing material can be omitted from responses of the Delphi panel nor can anything be added that is not panel generated" (Huckfeldt and Judd, 1975).

Round II: Feedback by Sections

The Round II questionnaire provided the first feedback of results to the Delphi panel. It consisted of a set of instructions (Appendix D), the list of objectives developed from Round I, and a rating scale for each objective. The members of each of the six groups received only those objectives submitted by members of their group.

A three part scale was used: high (H), average (A), and low priority (L). Panel members were asked to circle the letter which most nearly reflected their rating of the importance of each objective "H" signified a high priority and "L", a low priority, meaning that the objective indicated should not be included. "A" signified that the objectives should be taught, but only if convenient.

Round III: Consolidated Feedback

Round III of the survey provided the panelists with a summary of the responses of the other panel members in all sub-fields (or occupational groups), and asked them once again to indicate the priority they felt should be assigned each objective. Only the objectives ranked as high (H) by more respondents (in a sub-field) than marked either average (A) or low (L) were included. In other words, only those objectives selected as having a high priority by at least one group in Round II were included in the Round III questionnaire.

The Final Report

A final report (Appendix E) which included the objectives given a high rating by the combined sections of respondents was sent to all panelists. Once again, the mode of the distribution of responses determined consensus. Although no questionnaire was included, panelists were invited to submit further comments at any time.

Statistical treatment

The ratings of both individual objectives and categories of objectives were examined to determine any differences between the opinions of the marine science respondents and the respondents in the other sections. Chi-square calculations were used to discover which objectives were rated differently, and an analysis of variance

(F test) was performed to determine which categories of objectives were viewed differently by these two groups.

RESULTS

Numbers of Responses

The numbers of responses to the first mailing and each of the three subsequent questionnaire rounds are listed in Table 1. In all but one case, the percentages of responses in the questionnaire rounds were higher than that to the initial request to participate. This was to be expected since questionnaires were sent only to those who had agreed to answer them.

The drop in respondents to the third round questionnaire may have been due to an aversion to filling out the separate computer-scored answer sheet, as well as to a drop in interest. In the third round, respondents were asked to look again at objectives given a high priority by their section in the previous round, as well as many new objectives similarly selected by the respondents in the other five sections.

Round I: Development of Objectives

The lists of objectives provided by respondents to the first round questionnaire became the six separate questionnaires of the second round (Appendix D). The numbers of objectives submitted by each section of respondents are listed in Tables 2, 3, and 4. The total of all types of objectives (knowledge, skill, and attitude) from these tables is 99 for Section A, 337 for Section B, 60 for Section C, 163 for Section D, 56 for Section E, and 279 for Section F. Therefore Section E (Marine Operations) submitted the lowest total number of

TABLE 1

NUMBERS OF COMPLETED MARINE EDUCATION QUESTIONNAIRES RETURNED

Section	Requests Sent	Agreements to Participate	Questionnaires Returned: First Round (Development of Objectives)	Second Round (Feedback by Sections)	Third Round (Consolidated Feedback)
A. Marine Recreation	300	58 (19.3%)*	17 (29.3%)	31 (53.4%)	12 (20.7%)
B. Marine Science	300	132 (44.0%)	63 (47.7%)	73 (55.3%)	42 (31.8%)
C. Marine Resources	300	30 (10.0%)	12 (40.0%)	17 (56.7%)	7 (23.3%)
D. Marine Technology	216	52 (24.1%)	25 (48.1%)	33 (63.5%)	22 (42.3%)
E. Marine Operations	163	41 (25.2%)	15 (36.6%)	25 (70.0%)	12 (29.3%)
F. Interested Citizens	300	79 (26.3%)	46 (58.2%)	57 (72.2%)	30 (38.0%)
TOTALS	1579	392 (24.8%)	178 (45.4%)	236 (60.2%)	125 (31.9%)

*Percentages in this column are based on the number of requests sent (previous column). Percentages in the three following columns are based on the numbers in this column (those who agreed to participate).

TABLE 2

NUMBERS OF KNOWLEDGE OBJECTIVES SUBMITTED IN ROUND ONE

Section	Life in the water	Geography	Influence of water on our History	Economics	Environmental problems	Regulation and management	Safety	Miscellaneous	General Marine Science	The ocean floor and shore	How water moves	Weather	The nature of water	Defense	Total
	Category														
A. Marine Recreation	9	1	8	13	12	7	3	1							54
B. Marine Science	35	5	19	26	16	18		2	25	20	12	2	14		194
C. Marine Resources	5		1	15	7		2	1		2			1		34
D. Marine Technology	18	4	5	20	11	10	4		2	2	2	1	1	2	82
E. Marine Operations	6	3							1	3					13
F. Interested Citizens	30	6	8	39	27	8			18		4	4	2		146

TABLE 3

NUMBERS OF SKILL OBJECTIVES SUBMITTED IN ROUND ONE

Section	Weather	Fishing and seafood	Boating	Swimming and diving	Safety	General oceanographic	Life in the water	The ocean floor and shore	How water moves	Miscellaneous	Geography	Totals
	Category											
A. Marine Recreation	1	7	8	2	4							22
B. Marine Science	3	12	10	11	9	19	6	3	2			75
C. Marine Resources	4	6	1	3						2		16
D. Marine Technology	10	5	6	2	4	3				1	2	33
E. Marine Operations		1	2	2	2			5		4		16
F. Interested Citizens	2	8	13	12	7	15	4			3		64

TABLE 4

NUMBERS OF ATTITUDE OBJECTIVES SUBMITTED IN ROUND ONE

Section	Category: General	Our place in the ecosystem	Stewardship	Balance and priorities	Further study	Aesthetics	Economics	Seafood	Environmental problems	Management	Marine science	Totals
A. Marine Recreation	9	3	4	2	2	3						23
B. Marine Science	17	2	8	6	2	5	3	5	6	6	8	68
C. Marine Resources	8		1					1				10
D. Marine Technology	8		13	2	4	6	6	3	3	3		48
E. Marine Operations	10	2	3	4						3	5	27
F. Interested Citizens	31		10	7	2	5	4	2	5	3		69

objectives, while Section C (Marine Resources) returned the lowest number of questionnaires in this round (Table 1).

The categories listed in Tables 2, 3, and 4 were established by the investigator to organize the objectives submitted by the respondents. The respondents in the Marine Science section submitted objectives in more categories (all but 4) than did any other section. While this may be a result of this section having the largest number of respondents, the relatively small Marine Technology section ran a close second, having submitted no objectives in only 6 categories.

Round II: Feedback by Sections

The Third Round Questionnaire (Appendix D) contains all those objectives selected as high priority in the second round. Objectives for all six sections were consolidated into this one list. Among the knowledge objectives, the entire category called "the nature of water" was eliminated by the respondents during Round II, as were the skill categories of "fishing and seafood," "life in the water," "the ocean floor and shore" and "how water moves." No categories of attitude objectives were eliminated.

Four hundred four individual knowledge objectives, 182 skill objectives, and 129 attitude objectives listed on the second round questionnaire were not included on the third. They were eliminated either because they were ranked as average or low priority by respondents in their sections, or because they were redundant. Redundant responses (those included in two or more sections of the

second round questionnaire) were included only once in the third round questionnaire, with the exception of attitude objectives 59 and 61.

Objective 59 reads "that there should be a balance between resource development and habitat preservation in the marine environment." Objective 61 is identical except that the words "in the marine environment" are deleted. The inclusion of both was inadvertent, but made possible an assessment of the impact of the additional marine emphasis on the responses. The results are included in the next section.

The Third Round

Modal responses from the respondents in all sections (grouped together) were used to select those objectives which were included on the Final List of High Priority Marine Education Objectives. Thirty-eight knowledge objectives, 29 skill objectives, and 73 attitude objectives made it to this list. An asterisk (*) indicates that an objective was listed as high priority by all six groups (marine recreation, marine science, etc.).

I. A Virginia high school graduate should know:

A. General marine science.

*1. that the ocean contains not only living organisms, but is a physical, chemical and geologic system
2. the definition of oceans
3. the definition of estuaries
4. the definition of fresh water
5. the definition of wetlands
6. how oceans, estuaries, freshwater and wetlands are alike (and different) biologically
*7. why the bay is productive
8. the significance/relationship/importance of the marine environment to the total environment

*9. the "real" meaning of the term ecology
10. that despite its size and apparently limitless nature, the marine environment is a collection of ecosystems with the same basic characteristics, constraints, limits, and susceptibility to perturbation as terrestrial ecosystems
11. the importance of wetlands
12. the importance of rivers
13. the importance of the marine environment
14. that there is interaction between chemical and physical factors in the water and the marine life it contains
15. factors that influence the marine environment in Virginia (positive and negative)

B. Life in the water.
16. the importance of clean water to the health and spawning of fishes
17. The fragil nature of the marine ecosystem
18. what kills aquatic life
19. understand the "nursery" role of tidal marshes and estuaries

C. Geography.
20. the names and locations of the principal oceans and seas
21. that the earth's surface is more than 70% water

D. Environmental problems.
*22. that people can destroy in a few days what it will take years to replace
23. how to prevent water pollution
24. the effects of man-made pollutants
25. the effects of point sources of water pollution (sewage and industrial outfalls, etc)
26. the effects of destruction of estuaries
27. the effects of a "dead," polluted Chesapeake Bay
28. the effects of destruction of one part of the environment on the remaining parts
29. those portions of the system which appear most vulnerable to disturbance
30. the impact of destruction of wetlands
31. why the ocean is dying
32. the impact of chemical dumping
33. causes of water pollution

E. Defense.
34. the importance of seapower in geopolitics
35. the role of the Navy in national defense, particularly that of ensuring freedom of the seas and the

availability of resources in which we are not self-sufficient

F. Safety.
*36. safety rules for swimming
37. basic weather warnings

G. Miscellaneous.
38. A+B+C+D = global role of world ocean in the continued existence of spaceship earth

II. A Virginia high school graduate should be able to:

A. General oceanographic skills.
1. visit an intertidal area and leave it undisturbed
2. recognize environmentally detrimental conditions

B. Weather.
3. identify storm, gale or hurricane flag warnings

C. Swimming and diving.
4. swim 25 yards
5. swim 50 yards
6. swim 100 feet
7. swim 100 yards
*8. swim sufficiently to cope in water accidents
9. swim to pool's edge, after removing shoes, coats, etc.
10. deal with immersion
11. pass the Red Cross Beginners' Swimming Test
12. float
13. stay afloat 10 minutes
14. hold breath underwater

D. Safety.
15. perform CPR
16. perform drownproofing skills
*17. use a personal floatation device (life jacket)
18. recognize potential dangers on and in the water
19. perform basic first aid
20. use a ring buoy
21. use clothing as preservers
*22. survive in a potential drowning situation
23. practice water safety
24. properly use water safety equipment
25. survive in emergency situations that occur when the environment turns hostile
26. administer first aid for burns
27. administer first aid for shock
28. administer first aid for drowning

E. Miscellaneous.

*29. I believe that at the High School level, basic knowledge and appreciation should be stressed. Specific skills should be gained later in college, trade school, apprentice ships, on-the-job training, etc.

III. A Virginia High school graduate should feel:

A. General.

1. appreciation for Virginia's marine resources (including her coast)
2. appreciation for the value of wetlands
3. appreciation for the importance of fishes and shellfishes
4. appreciation for the quality of Virginia waters and marine life
5. appreciation for the complexity and delicacy of Virginia's coastal ecosystem
6. appreciation for the power, size, complexity, and central ecological role of the oceans
7. appreciation for conservation of fish and other wildlife
8. appreciation for the complexity and delicacy of Virginia's coastal ecosystem
9. appreciation for the commercial and recreational importance of Chesapeake Bay
10. appreciation for the sea as the cradle of life

*11. respect for the water

12. respect for others using public waters
13. respect for all sea life
14. respect for the support of the marine environment and culture
15. respect for equipment of others (such as crab pots)
16. respect for storms on the water
17. respect for floods
18. respect for the forces of the marine environment

*19. anti-litter along coast as well as from boats

20. resentment at destructive activities
21. motivated to help others in an emergency
22. a responsibility for our environment
23. respect for the hazards associated with the marine environment
24. that the marine environment is an integral part of Virginia
25. unashamed to be courteous and obey the rules of the road at all times

*26. an appreciation for all aspects of the marine environment, its value and the rationale for trade-offs in development versus preservation of the environment. We should help students to become informed voters and citizens, able to make decisions about the future of the marine environment. Beyond that, we do not have the right to "teach" attitudes in endless trade-offs and compromises involving our marine resources and environment

*27. education should not create attitudes--that is called "brainwashing." Education should be directed toward creating a logical thought process and providing information to consider or the knowledge of how to find information

B. Our place in the ecosystem.

28. that man is a part of the marine environment, not the owner

*29. that water is absolutely necessary for our survival

30. that man's survival is linked to the condition of the ocean and its resources

C. Stewardship.

31. protective of marine life

32. protective of endangered marine life

33. protective of the marine environment

34. protective of the Bay and surrounding waters

35. protective of marine resources

36. protective of liveable conditions

37. protective of wetlands

38. protective of the ecological balance of the marine world

39. protective of clean water

40. a feeling of personal importance to the effort to preserve the marine environment for future generations

41. concerned if man should interfere with erosion and dunes

42. an abhorence of wasteful and careless destruction of the marine environment

43. that the marine environment is fragile and perhaps non-renewable

44. that the marine environment is a fertile area not to be used as a dump

D. Balance and priorities.

45. that there should be a balance between resource development and habitat preservation in the marine environment

46. an appreciation for the diversity of coastal users and the need for compromises between different interests

47. that there should be a balance between resource development and habitat preservation
48. that there should be a balance between technology and the environment
49. willing to restrict certain developments if the resulting damage to the marine environment will be extensive
50. that exploitation of marine resources is not necessarily good or bad overall, but that the net benefits of each case must be considered for the long term
51. that there is more than one solution to a problem
52. a need to preserve the proper balance of nature
53. that there should be a balance between the future and immediate economic gain

E. Seafood.
54. that fishing (commercial and/or recreational) is a legitimate use of marine resources when effectively managed, and is not detrimental to the resource

F. Environmental problems.
55. that unabated pollution of ocean and estuary is undesirable
56. disgust and anger about blatant pollution such as Kepone
57. anti-litter along coast as well as from boats
58. the need to understand what can be dumped into the marine environment without causing unreasonable damage, and what cannot
59. the need to avoid future pollution and reduce present pollution
60. the need for anti-pollution measures
61. an active interest in how to prevent such destructive forces as oil spills, chemical spills, etc.
62. that pollution of estuaries will ultimately destroy the marine environment

G. Management.
63. the need for resource management
64. the need for enforcement of reasonable regulations, even if it costs

H. Further study.
65. the need for high school teachers to learn more marine ecology and appreciate its importance in the public school system
66. the need for the state to provide scholarships to working teachers for marine studies
67. a desire to learn more about the marine environment

I. Aesthetics.
   68. the uniqueness of Chesapeake Bay
   69. that water can be the scene of "calm excitement" rather than simply a place for racing around in faster and faster boats

J. Marine Science.
   70. that marine science plays an important role in their everyday life.
   71. that marine science is important for furthering knowledge of the marine environment and studying or monitoring its problems
   72. that marine science will contribute to national well being
   73. that marine science will result in efficient selection of programs which will make possible the wise use of marine resources

Entire categories of objectives deleted in this final evaluation were "The ocean floor and shore," "How water moves," "Weather," "The influence of water on our history," "Economics," and "Regulation and management" from the knowledge section; "Geography" and "Boating" from the skills section; and "Economics" from the attitude section. Eighty-one individual knowledge, 15 skill, and 43 attitude objectives were deleted because of average or low rankings.

Chi-square calculations involving the separate data for the six sections (A, B, C, D, E, and F) and three rankings (high, average, and low) were probably not valid because more than five percent of the cells in the resulting tables had expected counts of less than five responses. Since differences between marine science respondents and the others were of primary concern, data for the other sections were combined. Similarly, since only high priority items were being kept in the final list, average and low responses were pooled.

The resulting chi-square calculations showed that the marine science ratings for 24 knowledge, 5 skill, and 13 attitude objectives were significantly different at the .05 level from the combined ratings of the other sections. In eleven of these cases, objectives ranked as high by more than 50% of the marine science respondents were ranked as either average or low by more than 50% of the other respondents. In seven of these cases, the reverse was true and objectives ranked high by the other respondents were marked either low or average by a majority of the respondents in the marine science section (Tables 5, 6, and 7).

The items more highly valued by the marine science respondents dealt with food webs; the effect of large bodies of water on weather and climate; the power and inevitability of hurricanes and littoral drift; ecological balance; the balance between resource development and habitat preservation, between aesthetics and economics, and between technology and the environment; the willingness to restrict development; the need for resource management; and the need for the enforcement of reasonable regulations.

The items rated more highly by the respondents in the sections other than marine science were concerned with the prevention of water pollution; the effects of a "dead" Chesapeake Bay; the impact of sewage discharges and chemicals; and administering first aid for burns, shock, and drowning.

TABLE 5

Knowledge objectives from round three rated differently by the marine science section.

(Objectives for which ratings by the marine science section were significantly different at the .05 level from the combined ratings of the other sections).

Objective (from round three questionnaire)	Chi-square	Probability of a larger value of chi-square	Percentages of respondents rating objective as average or low priority	
			Section B Marine Science	All other sections Combined
30	8.162	0.0043	*45.00	73.02
31	7.462	0.0063	52.50	78.13
37	4.279	0.0386	77.50	91.94
39	4.575	0.0324	50.00	70.77
47	5.829	0.0158	*48.72	72.06
51	6.424	0.0113	80.00	55.88
53	5.224	0.0223	79.49	57.58
54	7.391	0.0066	87.50	63.24
55	6.174	0.0130	90.00	69.12
56	5.624	0.0177	84.21	62.12
62	5.667	0.0173	95.00	77.61
64	4.754	0.0292	89.74	71.64
65	7.967	0.0048	92.50	69.12
68	6.336	0.0118	87.18	64.71
69	14.503	0.0001	97.22	63.08
70	6.005	0.0143	82.50	59.70
71	3.892	0.0485	81.58	63.24
72	8.643	0.0033	94.74	70.59
73	5.287	0.0215	84.62	63.64
75	3.501	0.0613	53.85	*35.29
80	4.185	0.0408	75.00	55.22
81	9.268	0.0023	55.56	*25.37
90	4.574	0.0325	71.43	*49.23
94	5.554	0.0184	72.50	*49.25

*indicates that more than 50% of respondents gave objective a high ranking.

TABLE 6

Skill objectives from round three rated differently by the marine science section.

(Objectives for which ratings by the marine science section were significantly different at the .05 level from the combined ratings of the other sections).

Objective (from round three questionnaire)	Chi-square	Probability of a larger value of chi-square	Percentages of respondents rating objective as average or low priority	
			Section B Marine Science	All other sections Combined
8	4.765	0.0290	90.24	72.97
13	4.566	0.0326	*48.78	*28.77
40	7.026	0.0080	72.50	*46.48
42	6.449	0.0111	73.17	*48.61
43	9.477	0.0021	71.43	*41.43

*indicates that more than 50% of respondents gave objective a high ranking.

TABLE 7

Attitude objectives from round three rated differently by the marine science section.

(Objectives for which ratings by the marine science section were significantly different at the .05 level from the combined ratings of the other sections).

Objective (from round three questionnaire)	Chi-square	Probability of a larger value of chi-square	Percentages of respondents rating objective as average or low priority	
			Section B Marine Science	All other sections Combined
9	7.881	0.0050	*43.18	69.33
51	4.122	0.0423	*37.21	56.58
**59	9.028	0.0027	*29.55	58.11
**61	4.019	0.0450	*34.88	54.17
62	6.032	0.0140	*41.46	65.28
63	9.168	0.0025	*27.03	57.53
64	7.328	0.0068	*26.19	52.00
77	6.524	0.0106	80.95	57.53
92	4.415	0.0356	*39.02	59.46
93	6.989	0.0082	50.00	75.00
94	9.021	0.0027	*40.48	68.83
109	5.642	0.0175	90.24	71.25
110	4.400	0.0359	90.00	73.42

*indicates that more than 50% of respondents gave objective a high ranking.
**indicates that these objectives were identical except that "...in the marine environment" at the end of objective 59 was deleted from objective 61.

In Table 7, note that objecitves 59 and 61 were nearly identical, but received slightly different ratings. Although not statistically significant, the deletion of the words "...in the marine environment" seems to have resulted in a lower rating from the marine science section, and a higher rating from the combined remaining sections.

The results of the analysis of variance indicated that the opinions of marine science respondents differed from the opinions of other respondents on only four categories, at the .05 level of confidence. In all cases, the marine science respondents gave the categories a lower ranking than did the others (Table 8).

TABLE 8

Analysis of variance:

(Opinions of marine science respondents on categories of objectives which were significantly different at the .05 level from the opinions of the other respondents).

Category	Mean responses		F	Probability of a larger F
	Marine Science	All Others		
The influence of water on our history	*2.03	1.72	8.30	0.0048
Economics (knowledge)	2.12	1.84	10.25	0.0018
Defense (knowledge)	2.00	1.65	6.44	0.0124
Safety (skills)	1.89	1.63	5.48	0.0209

*1 = high priority, 2 = average priority, and 3 = low priority.

DISCUSSION AND CONCLUSIONS

Introduction

There were two primary purposes for this study. The first was to provide detailed, high-priority objectives for marine education in Virginia which were based on the opinions of members of all marine-related career fields as well as the general public. The second was to determine if these objectives differed from those of marine scientists and educators, and if so, in what ways. The subject of this chapter is the extent to which these purposes have been satisfied by the results described in the previous chapter, and a discussion of the ramifications of these findings.

The results of this study have been provided to Dr. Joseph Exline, Science Service, Department of Education of the Commonwealth of Virginia, for his use in program planning. Other educators have also indicated that the objectives developed are proving useful to them in various ways. Their related projects and ideas are discussed in this chapter.

Adequacy of the Objectives

Because of the respondent-developed nature of the objectives, the investigator's control of content was limited. Respondents were requested to be specific and detailed in their answers. Nonetheless, some objectives submitted, indicating that students should know such things as "marine ecology" or "oceanography," were so general as to be nearly useless. They were rejected or included as headings.

The 73 objectives on the final list were sufficiently specific and detailed to provide guidance in the development of educational programs. In practical terms, the average teacher or administrator would not wish to deal with a list of this length. Rejection of objectives judged less suitable was therefore probably not a problem in terms of numbers, but the question remains: Were any areas of possible major importance overlooked by the respondents? Comparisons to a previous study may provide some answers.

"A Conceptual Scheme for Studies of Aquatic Environments," by Maura Geens Tyrrell and Robert Stegner, has probably been in wider distribution than any of the other lists of objectives contained in Appendix B. The scheme has been used as a method for organizing the large collection of materials in Project COAST at the University of Delaware, which has been in national distribution for several years. It was also published in The Need for Marine and Aquatic Education (Goodwin and Schaadt, 1978). Dr. Stegner, the late marine education pioneer, claimed that the scheme included all that any of its many reviewers felt belong in marine education. It was therefore chosen for comparison to the results of the present study.

The "Conceptual Scheme" has a more logical organization than the list of objectives from this study, but it is both more general and less extensive in its coverage of marine topics. For example, it does not contain a specific reference to details such as the definitions of oceans or estuaries, nor does it mention that the earth's surface is

more than 70% water, which is one of the most sweeping (and often cited) facts contained in marine education materials.

The accuracy of the "Conceptual Scheme" was carefully checked by its authors, whereas this investigator could make no substantive revisions of the objectives submitted. However, a great many technical and practical marine experts reviewed the results in detail. The only item recognized by the investigator as technically questionable was eliminated when the respondents rated it as lower priority in a subsequent round.

Although the "Conceptual Scheme" did include some generalizations about the interactions of people and water (history, economics, etc.), it made no mention of skills, and dismissed attitudes with a statement on "...value judgements and ethical considerations." Although all the sections surveyed in this study agreed with the statement that "education should not create attitudes..." (Objective 27), the respondents went on to provide more attitude than knowledge and skill objectives combined.

Although the respondents were clearly uncomfortable with the abstract idea that attitudes should be consciously taught in our schools, they seemed very receptive to specific attitudes. In any event, none of the respondents indicated that they felt their positions on this issue were ambivalent. The point may be that whether or not we wish attitudes to be taught, they will be. It then

becomes prudent that we be aware of which attitudes we should encourage, and proceed with a deliberate plan to do so.

While the "Conceptual Scheme" may provide a place to put most of the objectives from this study within its broad framework, it is not a clear reflection of broadly held priorities, nor does it provide much guidance concerning the nature of the immense amount of detail underlying that framework. The objectives determined in this study, on the other hand, are priorities based on a broad opinion sample, and are considerably more detailed and specific.

Dr. Les Picker, Dr. Stegner's successor as Director of Project COAST at the University of Delaware, has asked this investigator to be one of several advisors assisting in the revision of the "Conceptual Scheme for Studies of Aquatic Environments." The results achieved in this Delphi study have provided clear guidance concerning not only the need for specific content changes, but have documented the importance of consulting a broader range of marine expertise than just that of marine scientists and educators.

We still may question whether any important items on the "Conceptual Scheme" were overlooked by the respondents to this study. Certainly, a number of broad statements found in the "Conceptual Scheme" are treated in little detail, if at all, in the final list from this study.

For example, the "Conceptual Scheme" includes the idea that "the chemical and physical behavior of water results in part from the

geometry of the water molecule." Although respondents in the Marine Science Section (Section B) did provide some fairly similar topics for inclusion on the second questionnaire (Appendix D), these were judged as lower priority by all the respondents voting together in the third round and were eliminated.

Those interested in more complete lists of objectives should refer both to the six more detailed lists which served as the second questionnaire (Appendix D), and to the lists developed by other marine educators (Appendices A and B). Those who do not look beyond the 73 high priority items provided as the final list from this study should keep in mind both the composition of the respondents who developed and rated the objectives (Table 1), and the fact that the other lists mentioned above are available. These must be consulted in any examination of marine education objectives which claims to be comprehensive.

Differences Between Marine Scientists and Educators, and the Other Survey Respondents

The Marine Science Section (Section B, Table 1) includes both the science and education respondents to the survey, the only two groups consulted in most other studies of marine education objectives. If we assume that the opinions of others with marine expertise and the lay public have a place in deciding these objectives, then future studies should also include these groups. Particularly important are their opinions on history, economics, defense, and safety, since marine

scientists and educators in Virginia did not rate objectives in these categories as highly as did the others surveyed (Table 8).

Use of the Objectives in Virginia and Elsewhere

As Cyphert and Gant (1971) have pointed out, a Delphi study can make its respondents feel a certain degree of responsibility or involvement with the objectives they helped determine. Such involvement can be an obvious advantage in developing a broader base of support for any program designed to help achieve such objectives, and may be particularly critical as marine educators fight for additional support and recognition during the 1980s.

Since the respondents to this modified Delphi study were all Virginians, and were asked to consider Virginia students in formulating their objectives, the results should be particularly useful in broadening the base of support for marine education in Virginia. One respondent said that this was the first time she knew of that anyone had asked shipbuilders their opinion on the subject. Since shipbuilders provide the largest source of private employment in the state, she felt that they should have been consulted long ago. Now that this study is complete, the continued participation of representatives from all the marine employment fields as well as the general public should be encouraged.

One traditional way to do this is by asking leaders from each group to meet regularly as part of an advisory group on marine education. Their advice should be helpful not only to the marine

educators at VIMS, but to active marine educators in such places as Roanoke, Richmond, Norfolk, Virginia Beach, and a number of northern Virginia communities.

Since Virginia educators make up a large part of the Mid-Atlantic Marine Education Association, use of the VIMS-Sea Grant Marine Education Objectives should also be particularly appropriate within that group. The other member states, from Delaware to North Carolina, share many concerns with Virginia and should find much they wish to support in the Virginia study.

Interest in the objectives has, in fact, been expressed by educators from such widely separated places as La Jolla, California; Groton, Connecticut; Vancouver, British Colombia; Woods Hole, Massachusetts; and Dauphin Island, Alabama. Although non-Virginia educators should be careful to consider local concerns which may differ from those in Virginia, there are at least two good reasons for using the Virginia results elsewhere. First, many of the objectives on the Virginia list obviously apply nearly anywhere. Second, the cost of duplicating so intensive and extensive a study will probably prevent most other states from doing so. A national study might be feasible and useful if provision were made for including special sections of objectives appropriate as priorities only in certain areas.

It seems more likely that future marine education studies will attempt to use rather than duplicate the effort of this study. A

dissertation project underway at the University of Maine, for example, is attempting to assess the marine-related knowledge of "average citizens" in northern New England by using a test based on the knowledge objectives developed in this study.

Objective number one on the "Northern New England Marine Education Inventory" was:

> "The average citizen of northern New England should know that the ocean contains not only living organisms, but is a physical, chemical, and geological system."

This statement is nearly identical to objective number one from this study, and the rest of the Maine test instrument is based on objectives which are also near-verbatim copies of the objectives developed in this study.

Another logical use of the results of this study would be to use the computer and microfiche-based Marine Education Materials System (Gammisch and Lanier, 1978) to determine what curricula, lesson plans, lab guides, and other materials have been produced concerning each of the objectives on the priority list. Then we can begin to develop the materials to support the programs needed to insure that all our citizens have the requisite knowledge, skills, and attitudes concerning the marine environment.

Limitations

The objectives developed in this study do not constitute a curriculum, nor are they necessarily suitable for guidance in the development of curricula at all levels. Obviously, a kindergarten student would not normally be expected to understand the definition of an estuary (objective 3, above), or the "real" meaning of ecology (objective 9, above). What is appropriate at each level should be the subject of continuing study, but these objectives should be accomplished some time before a student graduates from high school.

Most of the objectives can be pursued on a variety of levels, however, by varying the approach and amount of detail. For example, elementary students could certainly be introduced to the idea that Chesapeake Bay is an estuary. The more general description of an estuary, as a semi-enclosed coastal body of water with a free connection to the sea, could be taught at some point in high school.

Many of the objectives not only can, but should, be considered at all levels. Particular attention should be paid those objectives (marked with an asterisk) which were more uniformly held as being of high priority. The physics, chemistry, and geology of the sea can certainly be included in classes from kindergarten to high school, and training in swimming and the use of personal floatation devices seems logical as a basic part of any comprehensive educational effort.

Conclusions

While this is not a conclusive or final study of marine education objectives, it provides a well-supported basis for decisions concerning the future development of programs and materials. Now that we have a better idea of what should be taught, we should look at what has been taught and direct our most strenuous efforts toward those priority areas having received the least attention in the past.

APPENDIX A

Goals of Marine Education

(from other sources)

Goals of Marine Education as determined by:

I. Hawaii Marine Education Council (1975).

". . . to develop awareness, knowledge, and understanding of the total environment and the ocean's particular influence on man and society and to develop a committment to the wise use of the oceans and all other environments."

II. Curriculum Resources Center, Rhode Island College. (Pike, 1977).

Goals to be rank ordered:

A. Development of a "marine literate" society.

B. Provide education for a responsible citizenship.

C. Develop positive attitudes towards the marine environment.

D. Achieve an awareness of career opportunities in the marine area.

E. Familiarize students with operations and functions of marine occupations.

F. Provide for students to acquire entry level occupational skills.

G. Develop marine vocational competencies.

H. To explore ways in which a student's natural affinity for scientific concepts can be enlarged to include the environment's role his life.

I. To assist students to better understand that the environmental problems facing this nation must be part of their daily concerns and that these problems are world problems.

J. To help students achieve an understanding of scientific concepts, facts, and principles that are inherent in dealing with a problem solving approach as it relates to the aquatic environment.

K. To assist students toward a realization that environmental problems must be solved by a series of carefully constructed trade-offs.

L. To help children develop positive attitudes towards the role of scientists and science in environmental problem solving.

M. To help create an interest in and an appreciation of the environment.

N. To develop awareness, knowledge, and understanding of the ocean's relationship to the total environment and the ocean's particular influence on man and society.

O. To develop a commitment to the wise use of the oceans and all other marine environments.

P. To assist students to better understand their immediate environment and how it relates to the larger environment.

III. College of Marine Studies, University of Delaware (Goodwin and Schaadt, 1978).

A. To develop a public in which the majority of individuals has a basic understanding of the marine and aquatic environments as part of the total environment, and their importance to American life and society.

B. To create a public with an awareness of and concern for

water; to evolve a new "water ethic" embracing the proper uses, protection, and conservation of the oceans, the coastal zone, and our fresh water resources.

C. To motivate people toward taking part in decisions affecting the seas and fresh waters while equipping them with principles and information necessary to evaluate problems, opportunities and events.

IV. Sea Grant Workshop, University of Delaware, Newark, August 3, 1977. (Astro et al, 1977).

A. To create an educated populace as to the importance of the watered surfaces of the earth--in that we live in a closed system which is ultimately interdependent.

B. To provide a framework from which to initiate and coordinate marine educational activities so that such activities are as efficient and effective as possible.

C. To encourage awareness of the marine/hydro environment among the entire population in addition to the organized activities in K-12 education.

D. To identify marine career education.

E. To enhance general education curricula.

F. To create a citizen's political awareness of marine assets and problems.

G. To promote recreational enjoyment and awareness: e.g., sport fishing, boating, aquaria, resorts, and refuge areas.

H. To provide opportunity for teachers of all appropriate topics

to add a "marine" flavor to their existing courses.

I. To realize the role of the oceans in navigable waterways, resource supply, commerce, defense, and social and esthetic life of the USA.

J. To realize the potential impact of man's use of the oceans on cycles on the earth.

K. To use the sea to help in understanding our development as a society.

L. To use the sea as a subject to understand the creative processes in the humanities.

APPENDIX B

Objectives of Marine Education

(from other sources)

Objectives of Marine Education as determined by:

I. Hawaii Marine Education Council (1975).

. . . to enable students to develop:

A. An awareness of

1. the grandeur and aesthetic delicacy of the marine environment.
2. the recreational delights of the marine environment.
3. the holism of life, sea, land and atmosphere.
4. change, past and present, and the agents of change in the marine environment.
5. the distinction between man-made and natural marine environments.
6. the limits and capacity of man to control the marine environment.

B. A knowledge of

1. the literature of human interaction with the marine environment.
2. the environmental arts pertaining to the marine environment.
3. occupational opportunities associated with the marine environment.
4. the influence of the marine environment on world culture and specifically, Pacific and Hawaiin cultures.
5. the technologies that bear on the marine environment.

6. the disciplines that study the oceans and bring insight to issues bearing on its use.
7. the natural principles that govern the marine environment.
8. the social, economic, and political dimensions of marine issues that confront Hawaii and the world.
9. vehicles for citizen participation in decisions pertaining to the marine environment.

C. Skill in

1. swimming and other marine recreational activities.
2. seeking knowledge of the marine environment.
3. probing problems for substance, weighing alternatives, and making considered decisions concerning action pertaining to the marine environment.

D. An ethical stance concerning man's use of the marine environment.

E. A concern and commitment to the wise management of the marine environment.

II. School of Education, University of Delaware.

A Conceptual Scheme for Studies of Aquatic Environments by Maura Geens and Robert W. Stegner

A. An abundance of Water Makes the Earth Unique in our Solar System

1. Water has a unique combination of chemical and phsycial properties.
    a. The chemical and physical behavior of water results in part from the geometry of the water molecule.
    b. Within the range of temperature encountered on earth, water exists in three states: solid, liquid, and gas.
    c. Water exchanges large amounts of heat as it changes in state.

2. Water in the environment contains a variety of substances in suspension and in solution.
    a. Water is a very effective solvent.
    b. Dissolved and suspended substances affect the properties of water.
    c. Water in nature usually contains gases, organic compounds and mineral salts.
    d. Many substances dissolved or suspended in water are recycled through biological, geological, and chemical systems.

B. Aquatic Environments Interact with the Earth and its Atmosphere

1. Most of the earth's water is in the oceans.
    a. Oceans formed early in the history of the earth.
    b. The earth's surface water is constantly recycled

through the oceans.

2. The ocean waters are influenced by the earth's rotation, revolution, and position in the solar system.
   a. Ocean current patterns are affected by the absorption of solar energy.
   b. Ocean current patterns are affected by the earth's rotation.
   c. Tides result from gravitational forces of the earth, the moon, and the sun.
3. Energy is transferred wherever bodies of water meet the land or atmosphere.
   a. Atmospheric movements generate waves, surface currents, and coastal winds.
   b. Moving water shapes land forms.
   c. Subsurface topography is constantly changing.
   d. Land and sea floor movements generate waves.
   e. The aquatic environment helps to stabilize the earth's climate.
4. Materials carried from land masses influence the physical and chemical features of rivers, lakes, and coastal zones.
   a. Water, ice and wind carry minerals, nutrients, sediments and fresh water into rivers, lakes, and coastal zones.
   b. Fresh water from the land dilutes the coastal waters.

C. Aquatic Organisms Interact in Complex Ecosystems.

1. Life probably originated in the marine environment.
   a. Water facilitated the chemical evolution of organic compounds and coacervates.
   b. Chemical evolution resulted in heterotrophic systems.
   c. Autotrophs evolved from heterotrophs.
   d. Aquatic environments have supported the evolution of a diversity of species.

2. Aquatic organisms are adapted to their environments in different ways.
   a. Aquatic organisms are adapted developmentally, structurally, functionally, and behaviorally to their environments.
   b. Organisms in aquatic communities interact in balance with their environment and with one another.
   c. Populations of aquatic organisms are unevenly distributed.

3. Aquatic ecosystems depend on a constant flow of energy and the recycling of materials.
   a. Energy for the maintenance of aquatic ecosystems comes from the sun.
   b. Aquatic plants convert solar energy to food energy.
   c. Aquatic bacteria reduce organic materials to simpler

forms.

4. The stability of aquatic ecosystems tends to be directly proportional to the diversity of its populations and the complexity of relationships among them.

D. Man is Part of Aquatic Ecosystems.

1. Aquatic environments have affected the course of history and the development of human cultures.
   a. Oceans, lakes, and rivers have served as routes for the dispersal of human populations and cultures and for commercial transport.
   b. Proximity to aquatic environments and the availability of aquatic resources have influenced the cultures of many societies.

2. Man's activities may deplete and degrade aquatic ecoysystems.
   a. Exploitation of aquatic environments can cause depletion of many marine and freshwater species and the degradation of habitats.
   b. Man is changing aquatic ecosystems by adding pollutants to air and water.

3. Existing technology is capable of maintaining the health and usefulness of aquatic ecosystems.
   a. The maintenance of the health and usefulness of

aquatic environments depends on value judgements and ethical considerations.

b. Regional and international agreements will be essential for the conservation of aquatic resources.

III. Charleston County School District, Charleston, South Carolina

Discussion Guidelines for Ocean Sciences Conceptual Schemes Project (Teller and Awkerman, 1971). The following 15 questions were judged high in both academic content and relevance to the coastal environment by 161 oceanographers:

A. How is the ocean important to man?

B. What is oceanography?

C. What are the great surface currents of the world ocean?

D. What causes tides?

E. How does the sun affect the sea?

F. Where do we find life in the ocean?

G. What kinds of plants do we find in the sea?

H. What kinds of animals do we find in the sea?

I. What are the parts of the marine ecosystem?

J. How much food can we get from the sea?

K. Why is the continental shelf so productive?

L. What is an estuary?

M. How are estuaries important to us?

N. How has man changed the estuaries?

O. How does the sea affect the world's weather?

IV. University of Rhode Island

Major Points of Oceanography (Shafer, 1972).

A. The ocean covers 71 percent of the earth's surface.

B. It contains almost all the world's water.

C. Most of the world's major population centers are on harbors.

D. Seventy percent of the population of the United States lives in coastal states.

Seventy percent of the oxygen in the atmosphere is produced by the photosynthesis of phytoplankton.

E. Man uses the ocean for war, for its biological and mineral resources, for transportation and as a sewer.

F. The sea has played a very important role is shaping our history, music, art, and literature.

G. Today, the sea has taken on a new role for Americans. Always enjoyed as a source of recreation by a few, in many areas its recreational value has become most important for many people.

H. There is no science of oceanography; oceanography is the application of all man's science to the study of oceans.

V. Floating Marine Laboratory Program, Orange County, California (MacLean, 1976A).

A. Animals without backbones

1. protozoans

2. sponges

3. corals and their relatives
4. worms
5. mollusks
6. crustaceans
7. starfish and their relatives
8. sea squirts

B. Fish

1. form and function
2. types
3. ways of earning a living
4. procreation

C. Marine Ecology

1. cycle of life in the sea
2. food pyramid
3. food conversion
4. photosynthesis
5. populations

D. Plants of the sea

1. diatoms
2. dinoflagellates
3. algae
4. flowering plants
5. estuaries
6. mangroves

E. Myths and legends

1. kraken

2. Loch Ness Monster

3. Greek myths

4. Atlantis

5. dolphin legends

F. Literature and the sea

1. Moby Dick

2. 20,000 Leagues Under the Sea

3. accounts of expeditions (Heyerdahl, Cousteau)

4. poetry of the sea

5. music, painting

6. role of the sea in war

H. Land animals that went to sea

1. training of marine mammals

2. California Gray Whale

I. Four states of matter: Solid, Liquid, Gas and Plasma

1. Osmosis and reverse Osmosis

2. Saline water conversion, nine processes

J. Living resources

1. fishing techniques

2. farming the sea

3. food and drugs from the sea

K. Oceanologists at work

1. careers of the sea

2. sciences

3. law

4. resource management

5. commercial diving

L. Surface research

1. ships
2. Flip
3. satellites
4. bouys

M. Transportation and shipping

1. supertankers
2. hovercraft
3. hydrofoils
4. sailing vessels

N. Submerged research

1. submarines
2. bathyscaphs
3. remote systems
4. deep sea photography
5. underwater acoustics

O. Underwater habitats

1. Sea Lab
2. Conshelf
3. Hydrolab
4. Tektite

P. Diving

1. Aqua-lung
2. closed circuit breathing devices
3. gas under pressure

4. history and future medical aspects

Q. Expeditions

1. Challenger

2. Glomar Challenger

3. Agassiz

4. Nansen

R. Earth beneath the sea

1. plate tectonics

2. sea floor spreading

3. continental drift

S. Nonliving resources

1. energy from the sea

2. mining the sea

3. oil

T. Currents and weather

1. air-sea interface

2. currents and upwelling

3. hurricanes

4. tides

U. Coastlines and shore processes

1. waves and beaches

2. coastal features

3. man's impact

V. Classroom projects

1. building an aquarium

2. fish printing

3. bulding a wave or ripple tank

W. Zones of the sea

1. oceanic

2. neritic

3. deep sea

4. estuaries

X. Instruments of Oceanographers

1. Nansen bottles

2. bathythermograph

3. nets, grabs, coring

4. devices

Y. Recreation

1. types of recreational uses

2. conflicts

3. economic and environmental impact

Z. Resource Management

1. concept of non-renewable - limited resources

2. maximum sustainable yield

3. economics and conservation

AA. Law of the sea

1. does the sea belong to everybody or nobody

2. current and future problems

VI. Science Service, Department of Education of the Commonwealth of Virginia (Exline, 1978).

A. The Meaning of Oceanography

1. Why Study Oceanography?
2. Role the Oceans play in the Water Budget.
3. Problems encountered in surveying the Oceans.
4. Ocean floor compared to the continental surface.
5. Shape and structure of ocean basins.
6. How do we explore the ocean bottoms?
7. What is a continental shelf?
8. How do we measure and represent reliefs?

B. Physical Characteristics of the Oceans

1. Kinds of conditions that exist in the oceans.
2. Principle of uniformity of composition
3. Ocean water compared to a lake, pond, or streams.
4. Factors that affect the temperature of the oceans.
5. How salty are the oceans?
6. Methods for measuring ocean currents.
7. Map projections used by the oceanographer.
8. How does a navigator determine his position in the oceans?
9. Plotting an oceanic route of travel.

C. Physical Properties of Sea Water

1. Factors which influence surface tensions of a liquid.
2. Why do some objects float?
3. Do floating objects react the same in fresh and salt water?

4. What factors affect the density of sea water?
5. Determination of the density of sea water.
6. Does the ocean water conserve energy?
7. Difference in land and sea temperatures.
8. Development of a thermometer.
9. Cold and warm water currents.

D. Energy and the Sea

1. Kinds of energy
2. Sea-air interface and exchange of energy
3. Radiation and absorption of energy.
4. Optical properties of sea water.
5. Physiological role of light in marine ecosystems.
6. Depth and energy relationships.

E. Tides, Winds, and Waves

1. Changing pattern of the ocean's surface.
2. How waves are formed.
3. Factors that affect wave characteristics.
4. Tide producing forces
5. Predicting and measuring tides.
6. Seismic disturbances
7. How shorelines affect wave motion.
8. How the oceans affect the weather.
9. Hurricanes and typhoons.

F. Chemical Properties of Sea Water

1. Materials found in sea water.
2. Factors which influence the chemical properties of sea water.
3. Methods for identifying solutes in sea water.
4. Relative abundance of elements in sea water.

G. Exploring the Ocean Floor

1. Benthic measurements
2. Materials on the ocean floor.
3. Identification of bottom sediments
4. Developing the concept of scale model.

H. Isostasy and Subsidence

1. The theory of isostasy.
2. Relationships between faulting and isostasy.
3. Factors which affect deformation.
4. Change in positions of the oceans.

I. The Oceans Meet the Land

1. Classification of shorelines.
2. Geologic features associated with shorelines.
3. Change of shorelines with time.
4. Marine organisms and their effect on shorelines.
5. Ocean as a constructive and destructive force.

J. Environmental Oceanic Research

1. Man's influence on the world oceans.
2. Typical problems in oceanography today.
3. Natural resource from the sea.
4. Application of conservation to the sea.
5. Control and neutralization of potential pollutants in the world's oceans.

APPENDIX C

Solicitation Letter and Explanation of the Study Sent to Potential Respondents

COMMONWEALTH of VIRGINIA

Virginia Institute of Marine Science

Gloucester Point, Virginia 23062

William J. Hargis, Jr.
Director

Maurice P. Lynch
Sea Grant Director
(804) 642-2111

June 15, 1979

SEA GRANT PROGRAM

Dear Friend of Marine Education:

We need your opinion in deciding which aspects of our marine and aquatic environments we should emphasize in pre-college educational programs. Please help us in this important assessment of marine education needs in Virginia.

The term "marine education" has been used for several years to describe an effort to inform Americans about the marine environment, its resources, and the importance of using those resources wisely. Although biology has been an important part of this movement from the beginning, marine educators stress that other aspects of "the world of water" need more attention as well.

The VIMS Staff has been working with other organizations and individuals throughtout Virginia since 1940 in an effort to provide a comprehensive marine education program. We are convinced that there are many facts, attitudes, and skills which our citizens must have in order to properly use and enjoy our many and varied marine resources.

No one has yet attempted to obtain any broad consensus from Virginians as to what marine facts, attitudes, or skills are the most important. Such a fundamental needs assessment is necessary if we are to insure that our marine education program is aimed in the proper direction.

VIMS is therefore beginning a special survey of those involved in marine recreation, marine science, marine resources, marine technology, maritime operations, as well as a general sample of registered voters.

We ask that you agree to assist by participating in this survey.

We hope that you will be able to help us. Your perspective is essential if we are to develop truly comprehensive goals for marine education. This is your chance to let us know what you think marine education is all about. We also feel that you will be interested in the summarized information from other panel members as reported in each successive survey questionnaire.

We are enclosing a description of the survey method and a self-addressed postcard for your response. Please return the card within two weeks so that we can include you in the first round of questionnaires.

We will be grateful for your help.

Sincerely,

Jim Lanier

Sincerely,

Educ: Jim Lanier

JAL/cht

Enclosure

The VIMS Marine Education

Needs Assessment Survey

The survey will consist of a series of questionnaires with feedback to respondents after each step. This method of soliciting, organizing, and sharing expert opinions is called the Delphi Technique, since it was originally used to make predictions. It has also been used to gather data for the development of goals for the improvement of educational programs, and has been shown to be effective in this role.

If you agree to serve on the panel for this study, you will be asked to:

1. Participate on all four survey rounds. The first round will simply ask for your own ideas of what is most important for Virginians to learn about the marine environment. The second will provide you with the items developed in the first round, and ask for your priority rating of each item. The third questionnaire will include modes of the second round responses, and a request that you reconsider your own priorities and either agree with the group position or explain why you still feel that your rating is valid. The last questionnaire will give you feedback from round three, including a summary of minority opinions, and ask for a final revision of your position.

2. Be prompt in mailing your response. The first questionnaire should be in the mail on 1 June 1979, and one month will be allowed between each subsequent round. Since this includes delays for mailing

and tabulations of results, as well as the design and printing of the next questionnaire, your response must be in the mail within three days of the time you receive the questionnaire for your opinions to be included.

3. Provide the response to each questionnaire yourself. Do not delegate anyone else to respond for your, and give us your honest, personal opinions. If you do not respond by our deadline, "no opinion" will be entered for you on that round, but you will remain on the panel for future rounds. Making your response on each round should require less than 30 minutes of your time.

4. Keep the results of each questionnaire confidential until the final results are in. Although we feel that the educational objectives which finally result from this study will be useful even outside Virginia, some preliminary results may be misleading or subject to misinterpretation by those not familiar with the survey. We will also keep your response confidential, and the panel will remain anonymous. Your response will be numbered, however, so that we can tabulate results and provide individualized feedback.

D-1

I agree to participate in the

VIMS Marine Education Survey.

_____

(Signature)

I recommend that you also ask the

following person to participate:

Name: _____

Address: _____

_____

APPENDIX D

Cover Letters

and

Three Delphi Questionnaires

Cover Letter

for

First Delphi Questionnaire

Sea Grant
Marine Education Survey

School of Marine Science
College of William and Mary
Gloucester Point, Virginia 23062

RESULTS OF FIRST MAILING

Thank you for agreeing to tell us which aspects of marine education you feel should have priority in Virginia's pre-college educational system. We look forward to working with you on this and at least two more survey rounds.

Many of you were added to our list of respondents as the result of the many responses we had to our request for additional interested citizens. We were happy to see such interest, and a little surprised. We are anxious to see your first responses.

Our list of respondents, all of whom have agreed to provide their opinions, include 58 who work in marine recreation (aquaria, museums, boat building, marinas, and sport fishing), 132 in marine science (advisory services, education and training, regulatory and environmental, and research and development), 30 in marine resources (aquaculture, commercial fishing, mining and petroleum, and seafood processing), 52 in marine technology (marine construction, waterway and ocean engineering, and ship building), 41 in marine operations (merchant marine, inland operations, port and harbor, and offshore support), and 79 interested citizens (those not in marine related occupations).

DIRECTIONS

In filling out this first questionnaire, please think about what you feel a graduate of a Virginia high school should have learned in our schools about the marine environment, including our ocean areas, estuaries, and rivers.

Of the four questionnaires which are planned, this one will be the most demanding of your time and creativity. It is also the most crucial, since it will provide the materials upon which subsequent lists of objectives will be built. Only objectives provided by the advisory panel (of which you are a part) will be included in this study. We are asking that you actually formulate objectives in this round; future rounds will be largely a matter of checking your priorities.

In order to provide you with feedback on your own individual responses, we have printed an identification number on this questionnaire. Your response will remain anonymous for all other purposes of the study, however.

Please return the questionnaire by 27 August 1979. If you do not, "no opinion" will be entered for you this round, but you will be included in future rounds.

First Delphi Questionnaire

Marine Education

Needs Assessment Survey

Questionnaire I.

Directions

We are pleased that you have agreed to tell us what you think the priority objectives for Marine Education should be. In filling out this first questionnaire, please think about what you feel a graduate of a Virginia high school should have learned about the marine environment, including our ocean areas, estuaries, and rivers.

Of the four questionnaires which are planned, this one will be the most demanding of your time and creativity. It is also the most important and crucial, because it will provide the materials upon which subsequent lists of objectives will be built. Only objectives provided by the advisory panel of which you are a part will be included in this study. We are asking that you actually formulate objectives in this round; future rounds will by largely multiple choice.

In order to provide you with feedback on your own individual responses, we have printed an identification number on this questionnaire. Your response will remain anonymous for all other purposes of the study, however.

Please return the questionnaire by 15 June 1979. If you do not, "no opinion" will be entered for your this round, but you will be included in future rounds.

Return to: VIMS-Sea Grant

Marine Education Program

Gloucester Point, Virginia 23062

List no more than five objectives for each category which you feel are the most important. Your objectives should be simple, specific statements such as: "The effect of temperature, salinity, and pressure on the density of seawater" or "The uses which colonial Virginians and Indians made of oysters."

Regarding the marine environment and its resources, Virginia's high school graduates should

I. Know:

A.

B.

C.

D.

E.

II. Be able to:

A.

B.

C.

D.

E.

III. Feel:

Cover Letter

for

Second Delphi Questionnaire

COMMONWEALTH of VIRGINIA

Virginia Institute of Marine Science
Gloucester Point, Virginia 23062

William J. Hargis, Jr.
Director

Maurice P. Lynch
Sea Grant Director
(804) 642-2111

SEA GRANT PROGRAM

February 1, 1980

Dear Friend of Marine Education:

The first round responses to the marine education questionnaire were excellent, and a bit overwhelming. Objectives were submitted by 17 respondents in section "A", 63 in "B", 12 in "C", 25 in "D", 15 in "E", and 46 in "F", for a total of 178 completed questionnaires returned. To those of you who worked so hard on those questionnaires, I owe a great debt of thanks.

To those who agreed to participate, but were unable to respond to the first round, please take a look at the enclosed questionnaire. Complete it if you can. This time it is much easier, since all you have to do is circle one letter by each objective listed.

Circling the letter "H", for high priority, will indicate that you feel this objective must be taught if at all possible. "A", for average priority, means that it should be taught if convenient, but does not warrant special effort. "L", for low priority, will let us know that this objective should not be included in our precollege educational system. If you do not understand what an objective means, circle the question mark (?).

As you might expect, the objectives you submitted have been edited. We have added nothing, but both non-marine and extremely broad statements have been eliminated, and your objectives have been reorganized. We have assumed that all objectives formulated as a result of this study will be taught as part of our basic educational courses, or will be supplemental to them. In this study, however, we are looking only for specific, marine oriented objectives.

If you feel that an important, marine oriented objective which you submitted is not covered in the questionnaire you received, please let me know.

Thank you again for your help.

Sincerely,

Jim Lanier

James A. Lanier, Head
Marine Education Section

JAL:jah
Enclosure

Second Delphi Questionnaire

VIMS-SEA GRANT
MARINE EDUCATION SURVEY
SECOND ROUND
"A" SECTION

Please circle the letter corresponding to the priority you feel should be assigned to each objective.

Return completed form to:
J. Lanier
VIMS
Gloucester Pt., VA 23062

I. A Virginia high school graduate should know:

	High	Average	Low	Don't Understand
A. Life in the water.				
1. how to recognize edible & endangered species living in local waters	H	A	L	?
2. the life histories of the:				
a. oyster	H	A	L	?
b. clam	H	A	L	?
c. mussel	H	A	L	?
3. the habitat, season, and migration of common food and game fishes of this area	H	A	L	?
4. the habitat and migration of common shellfish of this area	H	A	L	?
5. the importance of wetlands	H	A	L	?
6. the importance of clean water to the health and spawning of fishes	H	A	L	?
7. the fragile nature of the marine ecosystem	H	A	L	?
B. Geography. the names and locations of all tributaries to the Chesapeake Bay	H	A	L	?
C. The influence of water on our history.				
1. historic uses of marine resources	H	A	L	?
2. the importance of the marine environment in U.S. history	H	A	L	?

3.	the influence of Chesapeake Bay history on our society including:				
	a. origin	H	A	L	?
	b. paleontology	H	A	L	?
	c. archaeology	H	A	L	?
	d. discovery	H	A	L	?
	e. role in colonial development	H	A	L	?
4.	who Matthew Fontaine Maury was and something about his life	H	A	L	?
D.	Economics.				
1.	current commercial uses of the marine environment	H	A	L	?
2.	relative impact on Virginia economy of:				
	a. commercial fishing	H	A	L	?
	b. marine recreation (boating, fishing, hunting, etc.)	H	A	L	?
	c. beauty of the water	H	A	L	?
	d. minerals	H	A	L	?
	e. chemicals	H	A	L	?
	f. commerce vs pleasure	H	A	L	?
3.	reasons (climate, chemical, etc.) why we have used resources this way	H	A	L	?
4.	where to look for knowledge about our resources	H	A	L	?
5.	how to conserve: i.e., how to handle and release unneeded catches	H	A	L	?
6.	the nutritional value of seafood	H	A	L	?
7.	how many people depend on the water for their livelihood	H	A	L	?
8.	about marine careers and the futures they offer	H	A	L	?
E.	Environmental problems.				
1.	that people can destroy in a few days what it will take years to replace	H	A	L	?
2.	how to prevent water pollution	H	A	L	?

3. the effects of:				
a. natural pollutants	H	A	L	?
b. man-made pollutants	H	A	L	?
c. point sources of water pollution (sewage and industrial outfalls, etc.)	H	A	L	?
d. non-point sources of water pollution (agriculture, erosion, etc.)	H	A	L	?
e. off-shore oil-well development	H	A	L	?
f. destruction of estuaries	H	A	L	?
g. littering	H	A	L	?
h. boat wakes on shoreline erosion	H	A	L	?
i. a "dead", polluted Chesapeake Bay	H	A	L	?
5. the plight of the whales and other threatened marine life	H	A	L	?
F. Regulation and management.				
1. laws and procedures governing:				
a. use of marine resources	H	A	L	?
b. ownership of the marine environment	H	A	L	?
c. reporting of:				
(1) water pollution	H	A	L	?
(2) marine life washed ashore	H	A	L	?
2. how to recognize water pollutants	H	A	L	?
3. the valuable but diminishing benefits of controlled conservation of marine resources	H	A	L	?
4. that much hard work and money is expended to better understand, preserve and improve our marine environment	H	A	L	?
G. Safety.				
1. rules for navigation and water safety	H	A	L	?
2. how to handle potentially dangerous marine life	H	A	L	?
3. what marine life should not be eaten	H	A	L	?

H. Miscellaneous. If properly structured, high school education has no time for nice to know information. All available time should be spent on basics such as reading, writing and mathematics..... agree disagree

II. A Virginia high school graduate should be able to:

A. Weather. read and interpret weather signs.....	H	A	L	?
B. Fishing and seafood.				
1. fish for all water animals, including:				
a. finfish.....	H	A	L	?
b. crabs.....	H	A	L	?
c. shellfish.....	H	A	L	?
2. identify edible and non-edible seafood.....	H	A	L	?
3. clean seafood.....	H	A	L	?
4. preserve seafood.....	H	A	L	?
5. prepare seafood.....	H	A	L	?
C. Boating.				
1. row.....	H	A	L	?
2. sail.....	H	A	L	?
3. handle a small power boat.....	H	A	L	?
4. handle a canoe.....	H	A	L	?
5. secure any vessel or object that could be carried away by wind or water.....	H	A	L	?
6. read tide and current tables.....	H	A	L	?
7. navigate.....	H	A	L	?
8. read charts.....	H	A	L	?
D. Swimming.				
1. swim:				
a. 25 yards.....	H	A	L	?
b. and float for one hour.....	H	A	L	?
E. Safety.				
1. perform:				
a. CPR.....	H	A	L	?
b. drownproofing skills.....	H	A	L	?

2.	use a personal floatation device (life jacket).....	H	A	L	?
3.	recognize potential dangers on and in the water.....	H	A	L	?

III. A Virginia high school graduate should feel:

A. General.				
1. appreciation for:				
a. Virginia's marine resources.....	H	A	L	?
b. wetland animals.....	H	A	L	?
c. wetland plants.....	H	A	L	?
d. the importance of fishes and shellfishes.....	H	A	L	?
e. the quality of Virginia waters and marine life....	H	A	L	?
f. the accomplishments of seafarers and their effect on history.....	H	A	L	?
2. respect for:				
a. the water.....	H	A	L	?
b. others using public waters.....	H	A	L	?
3. anti-litter along coast as well as from boats.....	H	A	L	?
B. Our place in the ecosystem.				
1. personal involvement (relationship) with the water....	H	A	L	?
2. that man is a part of the marine environment, not the owner.....	H	A	L	?
3. that water is absolutely necessary for our survival...	H	A	L	?
C. Stewardship.				
1. protective of:				
a. marine life.....	H	A	L	?
b. marine environment.....	H	A	L	?
c. the Bay and surrounding waters.....	H	A	L	?
2. a feeling of personal importance to the effort to preserve the marine environment for future generations	H	A	L	?
D. Balance and priorities.				
1. that there should be a balance between resource development and habitat preservation in the marine environment.....	H	A	L	?

2.	an appreciation for the diversity of coastal users and the need for compromises between different interests.....	H	A	L	?
E.	Further study.				
1.	a desire to learn more about the marine environment...	H	A	L	?
2.	eager to see tax dollars allocated to research on marine life.....	H	A	L	?
F.	Aesthetics. love of:				
1.	the beauty of Marine and Estuarine Environments.....	H	A	L	?
2.	the water.....	H	A	L	?
3.	the total aesthetic values of the marine environment..	H	A	L	?

VIMS - SEA GRANT
MARINE EDUCATION SURVEY
Second Round
Section "B"

Please circle the letter corresponding to the priority you feel should be assigned to each objective

Return completed questionnaire to:
Jim Lanier
VIMS
Gloucester Point, VA 23062

	High	Average	Low	Don't Understand
I. A Virginia high school graduate should know:				
A. General marine science.				
1. that the ocean contains not only living organisms, but is a physical, chemical and geologic system	H	A	L	?
2. the definition of, and be able to recognize and give examples of:				
a. oceans	H	A	L	?
b. estuaries	H	A	L	?
c. fresh water	H	A	L	?
d. wetlands	H	A	L	?
3. how the above are alike (and different):				
a. physically	H	A	L	?
b. chemically	H	A	L	?
c. biologically	H	A	L	?
d. geologically	H	A	L	?
4. the role of the world ocean in the following cycles:				
a. hydrologic	H	A	L	?
b. nutrient	H	A	L	?
c. carbon	H	A	L	?
d. oxygen	H	A	L	?
e. nitrogen	H	A	L	?
f. phosphorus	H	A	L	?

5.	why the Bay is productive	H	A	L	?
6.	the significance/relationship/importance of the marine environment to the total environment	H	A	L	?
7.	the "real" meaning of the term ecology	H	A	L	?
8.	the distribution of the following, in the waters of the earth:				
	a. temperature	H	A	L	?
	b. salinity	H	A	L	?
	c. light	H	A	L	?
9.	that despite its size and apparently limitless nature the marine environment is a collection of ecosystems with the same basic characteristics, constraints, limits, and susceptibility to perturbation as terrestrial ecosystems	H	A	L	?
10.	the importance of:				
	a. wetlands	H	A	L	?
	b. estuaries	H	A	L	?
11.	the types of research initiatives the U.S. should engage in to advance our welfare in the community of nations	H	A	L	?
B.	Life in the water.				
1.	how to recognize edible and endangered species living in local waters	H	A	L	?
2.	the names of animals and plants common to the Virginia coastal system, including:				
	a. animal and plant phyla	H	A	L	?
	b. finfishes	H	A	L	?
	c. molluscs	H	A	L	?
	d. crustaceans	H	A	L	?
	e. squid	H	A	L	?
	f. benthos	H	A	L	?
	g. phytoplankton	H	A	L	?
	h. zooplankton	H	A	L	?
	i. nekton	H	A	L	?

j.	submerged aquatic vegetation	H	A	L	?
k.	algae	H	A	L	?
l.	wetland fauna	H	A	L	?
m.	upland species around the Bay	H	A	L	?
n.	economically valuable species	H	A	L	?
o.	migratory species	H	A	L	?
p.	20 local estuarine plants and animals	H	A	L	?
q.	25 vertebrates	H	A	L	?
3.	the life histories of the:				
a.	oyster	H	A	L	?
b.	clam	H	A	L	?
c.	mussel	H	A	L	?
d.	blue crab	H	A	L	?
e.	other important commercial species in local waters	H	A	L	?
f.	catadromous fishes	H	A	L	?
g.	anadromous fishes	H	A	L	?
h.	non-migratory fishes	H	A	L	?
4.	that marine life is most abundant in the coastal zone and over the continental shelves	H	A	L	?
5.	in the Virginia bay and coastal regions, plant and animal:				
a.	distribution	H	A	L	?
b.	migrations	H	A	L	?
c.	seasonal density	H	A	L	?
d.	reasons for the above (environmental, etc.)	H	A	L	?
6.	in general terms, a typical food web (in relation to trophic levels, food energy pyramids and nutrient flow) in the:				
a.	ocean	H	A	L	?
b.	estuary	H	A	L	?
7.	plant interactions with water as related to chemical and physical reactions in water	H	A	L	?
8.	a minimum of 10 good laboratory experiments which can be done with local marine animals	H	A	L	?

C. The ocean floor and shore.

1. the geometry of the world ocean, including:				
a. size	H	A	L	?
b. shape	H	A	L	?
c. bathymetry	H	A	L	?
d. geomorphology of Chesapeake Bay	H	A	L	?
e. Virginia's continental shelf	H	A	L	?
2. theories on the formation of:				
a. the ocean	H	A	L	?
b. inland seas	H	A	L	?
c. beaches, and beach features	H	A	L	?
d. marshes	H	A	L	?
e. continental shelves	H	A	L	?
f. estuaries	H	A	L	?
g. the Chesapeake Bay	H	A	L	?
3. the theories of:				
a. plate tectonics (or continental drift)	H	A	L	?
b. sea level fluctuations (and how they influence the continental margins)	H	A	L	?
4. the definition of:				
a. estuary types	H	A	L	?
b. the beach	H	A	L	?
5. the effects of sedimentation and erosion on the marine environment and its resources	H	A	L	?
6. the effects of waves on shorelines	H	A	L	?
7. the difficulty of controlling beach erosion with manmade structures and why	H	A	L	?
8. chemical and physical reactions occurring in soils beneath the water	H	A	L	?

D. Geography

1. the names and locations of:				
a. all tributaries to the Chesapeake Bay	H	A	L	?
b. counties and cities on the Bay and its tributaries	H	A	L	?
c. the principal oceans and seas	H	A	L	?
2. that the earth's surface is more than 70% water	H	A	L	?

3. the general configuration of the Bay in Virginia	H	A	L	?
E. How water moves.				
1. that the ocean is part of a coupled fluid system (ocean/atmosphere)	H	A	L	?
2. the role of the world ocean in the earth's heat engine	H	A	L	?
3. causes of, and characteristics of:				
a. waves	H	A	L	?
b. tides (including effects of sun and moon, spring and neap tides)	H	A	L	?
c. currents	H	A	L	?
d. mixing	H	A	L	?
e. circulation in:				
(1) atmosphere	H	A	L	?
(2) world ocean	H	A	L	?
(3) deep sea	H	A	L	?
(4) Chesapeake Bay and adjacent waters	H	A	L	?
4. the theory of the salt-wedge estuary and its effects on Virginia's waters	H	A	L	?
5. how far tides and salt water go up the estuaries	H	A	L	?
F. Weather.				
1. the mechanisms of heat transfer from the equator to the poles through ocean currents, and the consequent influence on weather and climate	H	A	L	?
2. the characteristics of ocean tropical storms (hurricanes and typhoons)	H	A	L	?
G. The nature of water.				
1. physical and chemical properties of fresh, estuarine and sea water	H	A	L	?
2. theories on the origin of sea water	H	A	L	?
3. why the salt content of sea water is thought to be a conservative property	H	A	L	?
4. significance of the following in sea water:				
a. colligative properties	H	A	L	?

b. salinity	H	A	L	?
c. temperature	H	A	L	?
d. density	H	A	L	?
e. contaminants	H	A	L	?
f. light	H	A	L	?
g. dissolved oxygen (DO)	H	A	L	?
h. carbon dioxide	H	A	L	?
i. nitrates	H	A	L	?
j. phosphates	H	A	L	?
k. pH (alkalinity)	H	A	L	?
H. The influence of water on our history.				
1. historic uses of marine resources	H	A	L	?
2. the importance of the marine environment on U.S. history including:				
a. effects of tides and currents on daily life	H	A	L	?
b. man's role in (and impacts on) the marine environment, including law, science, politics, etc.	H	A	L	?
3. the influence of Chesapeake Bay history on our society, including:				
a. archeology	H	A	L	?
b. role in colonial development	H	A	L	?
c. settlement of Virginia	H	A	L	?
d. political issues	H	A	L	?
e. economic issues	H	A	L	?
f. environmental issues	H	A	L	?
g. shipyards	H	A	L	?
h. fishing	H	A	L	?
i. indians	H	A	L	?
j. colonists	H	A	L	?
k. civil war	H	A	L	?
4. who Mathew Fontaine Maury was and something about his life	H	A	L	?
5. the history of the Chesapeake Bay from indian times, including Spanish and English explorers, with an emphasis on the changes non-native Americans have made in the environment	H	A	L	?

6. the names of ten prominent oceanographers and their contributions to science (includes Virginians, of course)	H	A	L	?
7. that estuaries were most important communication and travel routes	H	A	L	?
8. why cities were built at the "fall line" or "fall zone"	H	A	L	?
I. Economics				
1. general				
a. current commercial uses of the marine environment	H	A	L	?
b. relative impact on the Virginia economy of:				
(1) commercial fishing	H	A	L	?
(2) marine recreation (boating, fishing, hunting, etc) ...	H	A	L	?
(3) estuaries	H	A	L	?
(4) salt marshes	H	A	L	?
(5) the shellfish industry	H	A	L	?
(6) different kinds of seafoods	H	A	L	?
(7) fish	H	A	L	?
(8) crabs	H	A	L	?
(9) oysters	H	A	L	?
c. the potential and actual energy resources of the ocean	H	A	L	?
d. the potential mineral resources of the ocean	H	A	L	?
e. the causes and effects of economic pressures on Virginia's coast	H	A	L	?
f. marine applications of the following concepts:				
(1) sustained yield	H	A	L	?
(2) renewable and non-renewable resources	H	A	L	?
(3) opportunity cost	H	A	L	?
2. fishing				
a. Virginia's chief commercial seafood products	H	A	L	?
b. how commercial species are harvested	H	A	L	?
c. global protein needs and marine protein production	H	A	L	?
d. aquaculture potential (animal or plant)	H	A	L	?
e. about fish protein concentrate (FPC) and krill	H	A	L	?
3. transportation				
a. the central importance of marine carriers in international trade	H	A	L	?

b. the effect of seaborne trade on Virginia's economy (jobs and dollar value)	H	A	L	?
4. recreation and leisure uses of waterways	H	A	L	?
5. employment				
a. about marine careers and the futures they offer	H	A	L	?
b. sources of information on advanced education and careers in marine science	H	A	L	?
J. Environmental problems.				
1. why we need to determine carrying capacities, and the impact of				
a. sewage discharges	H	A	L	?
b. too many nutrients	H	A	L	?
c. disappearance of submerged aquatic plants	H	A	L	?
d. dredging and spoil disposal	H	A	L	?
2. the effects of:				
a. man-made pollutants	H	A	L	?
b. upland development on estuarine water quality and wildlife	H	A	L	?
c. destruction of one part of the environment on the remaining parts	H	A	L	?
e. pollution on the health of the environment	H	A	L	?
3. the relationships of Virginia's coastal resources and problems to those of the nation	H	A	L	?
4. what actions have an adverse impact on the shellfish industry	H	A	L	?
5. those portions of the system which appear most vulnerable to disturbance	H	A	L	?
6. the benefits the Bay provides to Virginia, in order of their probable vulnerability to pollution	H	A	L	?
7. the rate at which wetlands are being destroyed	H	A	L	?
8. harmful aspects of the marine environment	H	A	L	?
9. the fragile nature of the marine environment	H	A	L	?
10. enough to write a brief essay describing the effects of some specific water pollutant on some specific organism in the Bay	H	A	L	?

K. Regulation and management.
   1. laws and procedures governing:
      a. use of marine resources ..... H A L ?
      b. reporting of:
         (1) wetlands violations ..... H A L ?
         (2) fish and game violations ..... H A L ?
      c. resolution of conflict (and its complex nature) ..... H A L ?
      d. managment of Virginia-Maryland conflict and cooperation in the Bay ..... H A L ?
   2. responsibilities of:
      a. institutions that govern ocean law ..... H A L ?
      b. Virginia Marine Resources Commission ..... H A L ?
      c. Water Control Board ..... H A L ?
      d. Dept. of Health ..... H A L ?
      e. Commission of Game and Inland Fisheries ..... H A L ?
   3. the tools used to resolve coastal issues, including:
      a. political ..... H A L ?
      b. legal ..... H A L ?
      c. economic ..... H A L ?
      d. social ..... H A L ?
      e. relation to biological and physical processes ..... H A L ?
   4. dependence of Bay management on proper management of wetlands ..... H A L ?
   5. structure of state research and marine education involvement ..... H A L ?
   6. the reason for National Seashores, their locations and fragility ..... H A L ?

L. Miscellaneous
   1. the uniqueness of Chesapeake Bay ..... H A L ?
   2. A+B+C+D = Global role of world ocean in the continued existence of spaceship earth ..... H A L ?

II. A Virginia high school graduate should be able to:

A. General oceanographic skills.				
1. take samples with:				
a. plankton net	H	A	L	?
b. seine	H	A	L	?
c. water testing kits	H	A	L	?
d. Nansen or other water bottle	H	A	L	?
2. measure:				
a. temperature	H	A	L	?
b. salinity	H	A	L	?
c. currents	H	A	L	?
d. wave periods	H	A	L	?
e. wave heights	H	A	L	?
f. wave lengths	H	A	L	?
g. turbidity	H	A	L	?
h. pH	H	A	L	?
i. dissolved oxygen (DO)	H	A	L	?
j. water pollution (type and level)	H	A	L	?
3. visit an intertidal area and leave it undisturbed	H	A	L	?
4. differentiate between perturbed and natural systems	H	A	L	?
5. set up and maintain a marine aquarium	H	A	L	?
6. set up and measure a marsh transect	H	A	L	?
7. design and conduct an experiment in marine science	H	A	L	?
B. Life in the water.				
1. sex blue crabs	H	A	L	?
2. use a key to identify marine organisms	H	A	L	?
3. "point out" the external anatomy of:				
a. 30 marine invertebrates	H	A	L	?
b. 30 marine vertebrates	H	A	L	?
4. examine specimens with:				
a. dissecting instruments	H	A	L	?
b. microscope	H	A	L	?

C.	The ocean floor and shore.				
	1. set up and measure a beach profile.....	H	A	L	?
	2. determine marine sediment types in the lab.....	H	A	L	?
	3. separate a beach sample mechanically and use graphic methods to determine average grain size.....	H	A	L	?
D.	How water moves.				
	1. plot the thermocline in a body of water.....	H	A	L	?
	2. demonstrate how to use temperature and salinity in tracing water masses.....	H	A	L	?
E.	Weather.				
	1. read in-coming weather.....	H	A	L	?
	2. use:				
	a. weather instruments to record data and analyze trends.....	H	A	L	?
	b. NOAA weather radio.....	H	A	L	?
F.	Fishing and seafood.				
	1. fish for all water animals, including:				
	a. finfishes.....	H	A	L	?
	b. crabs.....	H	A	L	?
	c. oysters.....	H	A	L	?
	d. clams.....	H	A	L	?
	e. from pier.....	H	A	L	?
	f. from boat.....	H	A	L	?
	g. with peeler crab.....	H	A	L	?
	h. with bloodworm.....	H	A	L	?
	i. with crab pot.....	H	A	L	?
	2. clean seafood.....	H	A	L	?
	3. prepare seafood.....	H	A	L	?
	4. eat more seafood.....	H	A	L	?

G.	Boating.				
	1. row	H	A	L	?
	2. handle:				
	a. small power boat	H	A	L	?
	b. larger power boat	H	A	L	?
	c. canoe	H	A	L	?
	d. an outboard motor	H	A	L	?
	e. CB radio	H	A	L	?
	3. read tide and current tables	H	A	L	?
	4. navigate	H	A	L	?
	5. read charts	H	A	L	?
	6. distinguish types of buoys	H	A	L	?
H.	Swimming and diving.				
	1. dive	H	A	L	?
	2. swim:				
	a. 25 yards	H	A	L	?
	b. 50 meters	H	A	L	?
	c. 100 meters	H	A	L	?
	d. one-fourth mile and stay afloat 1 hour	H	A	L	?
	e. a half mile	H	A	L	?
	f. sufficiently to cope in water accidents	H	A	L	?
	g. to pool's edge, after removing shoes, coats, etc	H	A	L	?
	3. stay afloat for one hour fully clothed and without aids	H	A	L	?
	4. judge the effects of waves or currents on their ability	H	A	L	?
	5. float	H	A	L	?
I.	Safety.				
	1. perform:				
	a. CPR	H	A	L	?
	b. drownproofing skills	H	A	L	?

c. basic first aid.....	H	A	L	?
d. advanced first aid.....	H	A	L	?
e. life saving.....	H	A	L	?
2. use:				
a. a personal floatation device (life jacket).....	H	A	L	?
b. a ring buoy.....	H	A	L	?
c. clothing as preservers.....	H	A	L	?
3. treat stings and bites.....	H	A	L	?

III. A Virginia high school graduate should feel:

A. General.

1. appreciation for:
   a. Virginia's marine resources (including her coast) ..... H A L ?
   b. the complexity and delicacy of Virginia's coastal ecosystem ..... H A L ?
   c. the power, size, complexity, and central ecological role of the oceans ..... H A L ?
   d. the power and inevitability of hurricanes and littoral drift ..... H A L ?
   e. the role of each part of the marine ecosystem in the total biosphere ..... H A L ?
   f. the importance of Tidewater's Naval installations ..... H A L ?
   g. the historic ties of Virginia to the sea and Bay ..... H A L ?
   h. the many forms of marine recreation ..... H A L ?
   i. marine fossils found in Virginia ..... H A L ?
2. respect for:
   a. all sea life ..... H A L ?
   b. the support of the marine environment and culture ..... H A L ?
   c. equipment of others (such as crab pots) ..... H A L ?
3. secure and relaxed around the water ..... H A L ?
4. that the ocean shrinks in size as our means of transportation and population increase ..... H A L ?
5. resentment at destructive activities ..... H A L ?
6. motivated to help others in an emergency ..... H A L ?
7. attitudes or feelings are developed within each person in response to his perception of reality. Educators should present the facts and leave attitude development out of it ..... agree disagree

B. Our place in the ecosystem.

1. that man's survival is linked to the condition of the ocean and its resources ..... H A L ?
2. akin to the cetacea ..... H A L ?

C. Stewardship.
   1. protective of:
      a. endangered marine life ..... H A L ?
      b. marine food chains ..... H A L ?
      c. the Bay and surrounding waters ..... H A L ?
      d. marine resources ..... H A L ?
      e. the marine environment ..... H A L ?
      f. liveable conditions ..... H A L ?
      g. wetlands ..... H A L ?
   2. that our waters belong to everyone, so that each of us has a personal responsibility to preserve, protect and improve the marine environment ..... H A L ?

D. Balance and priorities.
   1. that there should be a balance between:
      a. resource development and habitat preservation ..... H A L ?
      b. aesthetics and economics ..... H A L ?
      c. technology and the environment ..... H A L ?
   2. an appreciation of the diversity of coastal users and the need for compromises between different interests ..... H A L ?
   3. a personal rating of most and least important uses of the marine environment, including waste disposal, oil drilling, oil refinery, seafood, recreation, etc. ..... H A L ?
   4. willing to restrict certain developments if the resulting damage to the marine environment will be extensive ..... H A L ?

E. Economics. the importance of the Bay as:
   1. economic base ..... H A L ?
   2. natural resource ..... H A L ?
   3. highway ..... H A L ?

F. Seafood.
   1. the importance of:
      a. the seafood industry to our future ..... H A L ?
      b. maintaining resources for future fishermen ..... H A L ?

2. concern for the problems of the commercial fisherman	H	A	L	?
3. enjoyment of:				
a. eating seafood	H	A	L	?
b. tasting new seafood items	H	A	L	?
G. Environmental problems.				
1. that unabated pollution of ocean and estuary is undesirable ...	H	A	L	?
2. the importance of clean water to our future	H	A	L	?
3. disgust and anger about blatant pollution such as Kepone	H	A	L	?
4. that not all pollution is bad, some can enrich	H	A	L	?
5. anti-litter along coast as well as from boats	H	A	L	?
6. that man is destroying the marine ecosystem by building, dredging, filling, etc.	H	A	L	?
H. Management.				
1. the need for:				
a. resource management	H	A	L	?
b. more coastal zone managment	H	A	L	?
c. simplification of resource administration for the Bay	H	A	L	?
d. management of upland areas	H	A	L	?
e. enforcement of reasonable regulations, even if it costs ...	H	A	L	?
2. a positive frame-of-mind towards the Coast Guard and other regulatory agencies	H	A	L	?
I. Marine science.				
1. that marine science:				
a. plays an important role in their everyday life	H	A	L	?
b. is important for furthering knowledge of the marine environment and studying or monitoring its problems	H	A	L	?
c. should be assertively supported by the U.S.	H	A	L	?
d. and marine affairs are enjoyable studies	H	A	L	?
e. involves tedium	H	A	L	?
2. supportive of:				
a. marine scientists in Virginia	H	A	L	?
b. fine institutions like VIMS	H	A	L	?

	c. marine education	H	A	L	?
J.	Further study.				
	1. a desire to learn more about the marine environment	H	A	L	?
	2. curious about unsolved/unknown aspects of the oceans	H	A	L	?
K.	Aesthetics.				
	1. love of the beauty of marine and estuarine environments	H	A	L	?
	2. a sense of beauty and harmony in the natural processes that occur in the marine environment	H	A	L	?
	3. an appreciation for marine art and literature	H	A	L	?
	4. that dunes and open beach are more appealing than rows of condominiums on the waterfront	H	A	L	?
	5. the uniqueness of Chesapeake Bay	H	A	L	?

VIMS - SEA GRANT
MARINE EDUCATION SURVEY
SECOND ROUND
"C" SECTION

Please circle the letter corresponding to the priority you feel should be assigned to each objective:

Return completed form to:
Jim Lanier
VIMS
Gloucester Point, VA 23062

I. A Virginia high school graduate should know:

	High	Average	Low	Don't Understand
A. Life in the water.				
1. the life histories of important commercial species in local waters.....	H	A	L	?
2. the habits of:				
a. fishes.....	H	A	L	?
b. oysters.....	H	A	L	?
c. other products of the waters.....	H	A	L	?
3. the effect of temperature on seafood species in different areas.....	H	A	L	?
B. The ocean floor and shore.				
1. theories on the formation of the Chesapeake Bay	H	A	L	?
2. the effects of sedimentation and erosion on the marine environment and its resources.....	H	A	L	?
C. The nature of water. Where to locate high salinity and low salinity waters and how to tell the difference....	H	A	L	?
D. The influence of water on our history. The importance of Virginia's waterways in the development of our communities and vice-versa.....	H	A	L	?

E. Economics.					
1. general					
a. current commercial uses of the marine environment.	H	A	L	?	
b. the potential and actual energy resources of the ocean.....	H	A	L	?	
c. the potential mineral resources of the ocean.....	H	A	L	?	
d. the current and historic effect of the marine environment on the state's economic development...	H	A	L	?	
e. the economy of the coastal plain, in dollars and cents.....	H	A	L	?	
f. about undersea mining.....	H	A	L	?	
2. fishing					
a. Virginia's chief commercial seafood products.....	H	A	L	?	
b. outdated methods used to harvest seafood.....	H	A	L	?	
c. the following about seafood harvested in Virginia:					
(1) dollar value.....	H	A	L	?	
(2) effect on employment in entire state.....	H	A	L	?	
(3) the importance of its food value to the nation.....	H	A	L	?	
(4) its use as food for domestic animals.....	H	A	L	?	
(5) the great amount produced.....	H	A	L	?	
(6) the potential for producing more.....	H	A	L	?	
d. setbacks that plague shellfish such as oysters, clams, crabs, and scallops.....	H	A	L	?	
F. Environmental problems.					
1. the impact of:					
a. sewage discharges.....	H	A	L	?	
b. too many nutrients.....	H	A	L	?	
c. dredging and spoil disposal.....	H	A	L	?	
d. oil spills.....	H	A	L	?	
e. chemicals used by farmers, industry, etc.....	H	A	L	?	
f. bulkheads and piers on marshes.....	H	A	L	?	
g. dams.....	H	A	L	?	

G. Safety.
1. safety procedures and equipment needed on vessels..... H A L ?
2. the dangers of being on the water in a wind or electrical storm..... H A L ?

H. Miscellaneous. I think a student should be able to read, write and do math. The rest a student will get if he is interested. Our schools are poor, and fancy words as "formulate objectives" and "feedback" does not replace the three "r's." agree disagree

II. A Virginia high school graduate should be able to:

A. Seafood.
1. survive on seafood..... H A L ?
2. clean seafood..... H A L ?
3. prepare seafood..... H A L ?
4. not be intimidated by seafood as a household item..... H A L ?

B. Boating.
1. read tide and current tables..... H A L ?
2. navigate..... H A L ?
3. read charts..... H A L ?
4. use a protractor..... H A L ?
5. read a compass..... H A L ?
6. recognize sand bars..... H A L ?

C. Swim..... H A L ?

D. Safety.
1. perform:
a. life saving..... H A L ?
b. survival techniques..... H A L ?
2. detect trouble on another boat..... H A L ?

E. Miscellaneous.

1. I believe that at the H.S. level, basic knowledge and appreciation should be stressed. Specific skills should be gained later in college, trade school, apprentice ships, OJT, etc..... agree disagree
2. no skills required unless the water is to be the place where he earns his living..... agree disagree

III. A Virginia high school graduate should feel:

A. respect for:

1. the water..... H A L ?
2. others using public waters..... H A L ?
3. equipment of others (such as crab pots)..... H A L ?
4. marine resources..... H A L ?
5. storms on the water..... H A L ?
6. floods..... H A L ?

B. a responsibility for our environment..... H A L ?

C. that boating is enjoyable..... H A L ?

D. that Virginia is tops in seafood on the east coast and that there are none better in the world than the Chesapeake Bay oyster..... H A L ?

E. an appreciation for all aspects of the marine environment, its value and the rationale for trade-offs in development versus preservation of the environment. We should help students to become informed voters and citizens, able to make decisions about the future of the marine environment. Beyond that, we do not have the right to "teach" attitudes in endless trade-offs and compromises involving our marine resources and environment..... agree disagree

VIMS - SEA GRANT
MARINE EDUCATION SURVEY
SECOND ROUND
SECTION "D"

Please circle the letter corresponding to the priority you feel should be assigned to each objective

Return completed questionnaire to:
Jim Lanier
VIMS
Gloucester Point, VA 23062

	High	Average	Low	Don't Understand
I. A Virginia high school graduate should know:				
A. General marine science.				
1. what the hydrosphere is	H	A	L	?
2. the significance/relationship/importance of the marine environment to the total environment	H	A	L	?
B. Life in the water.				
1. the names of animals and plants common to the Virginia coastal system, including:				
a. commercial and sport species from microscopic to fishes	H	A	L	?
b. birds	H	A	L	?
c. shellfishes	H	A	L	?
d. finfishes	H	A	L	?
e. saltwater species	H	A	L	?
f. freshwater species	H	A	L	?
g. brackish water species	H	A	L	?
2. the life histories of the:				
a. blue crab	H	A	L	?
b. shellfish	H	A	L	?
c. finfish	H	A	L	?
3. the effect of the following on aquatic life:				
a. temperature	H	A	L	?

b. salinity	H	A	L	?
c. dissolved oxygen (DO)	H	A	L	?
d. seasons of the year	H	A	L	?
4. the ecological factors that make Virginia waters unique	H	A	L	?
5. what feeds aquatic life	H	A	L	?
6. what kills aquatic life	H	A	L	?
7. general up-stream ranges of spawning fishes	H	A	L	?
C. The ocean floor and shore.				
1. the effects of sedimentation and erosion on the marine environment and its resources	H	A	L	?
2. the effects of waves on shorelines	H	A	L	?
D. Geography. the names and locations of:				
1. all tributaries to the Chesapeake Bay	H	A	L	?
2. the principal oceans and seas	H	A	L	?
3. adjacent land masses	H	A	L	?
4. lakes	H	A	L	?
E. How water moves. causes of, and characteristics of:				
1. tides (including effects of sun and moon, spring and neap tides)	H	A	L	?
2. currents	H	A	L	?
F. Weather. the effect of large bodies of water on weather and climate	H	A	L	?
G. The nature of water. physical and chemical properties of fresh, estuarine, and sea water	H	A	L	?
H. The influence of water on our history.				
1. the influence of Chesapeake Bay history on our society, including:				
a. development	H	A	L	?
b. settlement	H	A	L	?
c. shipyards	H	A	L	?

d. nursery for fish and shell life	H	A	L	?
2. history associated with Virginia's marine coastline	H	A	L	?
I. Economics.				
1. general				
a. current commercial uses of the marine environment	H	A	L	?
b. relative impact on the Virginia economy of:				
(1) commercial fishing	H	A	L	?
(2) marine recreation (boating, fishing, hunting, etc.)	H	A	L	?
(3) marine transportation (ports and shipping)	H	A	L	?
(4) tourism	H	A	L	?
(5) waste disposal	H	A	L	?
(6) shipbuilding and repair	H	A	L	?
c. the potential of the oceans as a source of:				
(1) minerals	H	A	L	?
(2) fresh water	H	A	L	?
(3) energy	H	A	L	?
2. fishing				
a. Virginia's chief commercial seafood products	H	A	L	?
b. the size of the industry that depends on local fishes, in terms of both dollars and people	H	A	L	?
c. how seafood is:				
(1) harvested	H	A	L	?
(2) marketed	H	A	L	?
3. transportation				
a. the meaning of the expression "merchant marine" and the general nature of the shipping business	H	A	L	?
b. the importance of ocean shipping to the availability of critical resources such as oil, tin, chrome, etc.	H	A	L	?
c. fundamentals of naval architecture, including:				
(1) Achimedes' principle	H	A	L	?
(2) speed/length ratio	H	A	L	?
(3) division of drag into wave making	H	A	L	?
4. employment. About marine careers and the futures they offer	H	A	L	?
J. Environmental problems.				
1. the impact of the following on the marine environment and man:				
a. man-made structures	H	A	L	?

b. water pollution	H	A	L	?
c. Kepone	H	A	L	?
d. dredging	H	A	L	?
e. overdevelopment	H	A	L	?
f. overfishing	H	A	L	?
g. destruction of wetlands	H	A	L	?
h. abuse of recreation facilities	H	A	L	?
2. the life expectancy of various pollutants	H	A	L	?
3. the destructive effects of marine corrosion	H	A	L	?
4. why the ocean is dying	H	A	L	?
K. Regulation and management.				
1. laws and procedures governing:				
a. use of marine resources	H	A	L	?
b. water pollution	H	A	L	?
c. waterways	H	A	L	?
d. marine bottoms	H	A	L	?
e. wetlands	H	A	L	?
f. oil spills	H	A	L	?
2. about regulatory agencies which protect the marine environment, including:				
a. names	H	A	L	?
b. functions	H	A	L	?
c. effectiveness	H	A	L	?
d. whether they are strong enough	H	A	L	?
L. Defense.				
1. the importance of seapower in geopolitics	H	A	L	?
2. the role of the Navy in national defense, particularly that of ensuring freedom of the seas and the availability of resources in which we are not self-sufficient	H	A	L	?
M. Safety.				
1. rules of the road	H	A	L	?
2. small boat safety	H	A	L	?
3. safety rules for swimming	H	A	L	?
4. basic weather warnings	H	A	L	?

II. A Virginia high school graduate should be able to:

A. General.				
1. measure:				
a. temperature	H	A	L	?
b. salinity	H	A	L	?
c. pH	H	A	L	?
2. camp overnight on an ocean beach	H	A	L	?
3. conduct elementary laboratory tests identifying water pollutants	H	A	L	?
B. Life in the water.				
1. sex blue crabs	H	A	L	?
2. identify:				
a. local fishes	H	A	L	?
b. plants	H	A	L	?
C. Geography.				
1. make a map of Virginia identifying Bay, principal river and shore features	H	A	L	?
2. read maps, charts, graphs, etc. which present data on the marine environment, resources, geography, etc	H	A	L	?
D. Fishing and seafood.				
1. fish, including:				
a. finfishes	H	A	L	?
b. crabs	H	A	L	?
c. oysters	H	A	L	?
d. shellfishes	H	A	L	?
e. nets	H	A	L	?
f. crab pots	H	A	L	?
g. surf casting	H	A	L	?
h. deep sea	H	A	L	?
2. clean seafood	H	A	L	?
3. prepare seafood	H	A	L	?

E. Boating.
1. row..... H A L ?
2. sail..... H A L ?
3. handle a small power boat..... H A L ?
4. navigate..... H A L ?
5. use marine communications..... H A L ?

F. Swimming and diving.
1. SCUBA dive..... H A L ?
2. swim:
a. 100 feet..... H A L ?
b. 100 yards..... H A L ?
c. with snorkle and flippers..... H A L ?
3. stay afloat 30 min. in deep water..... H A L ?
4. deal with immersion..... H A L ?

G. Safety.
1. survive in a potential drowning situation..... H A L ?
2. perform life saving techniques associated with water..... H A L ?

III. A Virginia high school graduate should feel:

A. General.
1. appreciation for:
a. the power, size, complexity, and central ecological role of the oceans..... H A L ?
b. the many forms of marine recreation..... H A L ?
c. the use of water facilities..... H A L ?
d. the relationship between man's activities and our fisheries..... H A L ?
e. the life of a mariner or waterman..... H A L ?
2. secure and relaxed around the water..... H A L ?
3. respect for the hazards associated with the marine environment.. H A L ?
4. a part of the marine ecosystem, as the result of knowledge of it..... H A L ?

B. Stewardship.
   1. protective of:
      a. marine life..... H A L ?
      b. marine resources..... H A L ?
      c. the marine environment..... H A L ?
      d. aquatic plants..... H A L ?
      e. wetlands..... H A L ?
      f. bottom lands..... H A L ?
      g. scenic areas..... H A L ?
      h. the ecological balance of the marine world..... H A L ?
      i. marine commerce..... H A L ?
      j. marine recreational industries..... H A L ?
   2. a feeling of personal importance to the effort to preserve the marine environment for future generations..... H A L ?
   3. concerned if man should interfere with erosion and dunes..... H A L ?
   4. an abhorence of wasteful and careless destruction of the marine environment..... H A L ?

C. Balance and priorities.
   1. that there should be a balance between resource development and habitat preservation..... H A L ?
   2. that exploitation of marine resources is not necessarily good or bad overall, but that the net benefits of each case must be considered for the long term..... H A L ?

D. Economics.
   1. the economic importance of:
      a. marine resources..... H A L ?
      b. Virginia's marine industries..... H A L ?
      c. energy from the sea..... H A L ?
   2. the need:
      a. to improve marine industry..... H A L ?
      b. for the U.S. to have a merchant marine capable of satisifying a reasonable level of our countries needs..... H A L ?
   3. that the marine environment should be used for making a living, not only for pleasure..... H A L ?

E. Seafood.
   1. the importance of:
      a. the seafood industry to our future..... H A L ?
      b. maintaining resources for future fishermen..... H A L ?
      c. concern for the problems of the commercial fisherman..... H A L ?

F. Environmental problems.
   1. that unabated pollution of ocean and estuary is undesirable..... H A L ?
   2. the importance of clean water to our future..... H A L ?
   3. the need to understand what can be dumped into the marine environment without causing unreasonable damage, and what cannot..... H A L ?

G. Management. The need for:
   1. enforcement of reasonable regulations, even if it costs..... H A L ?
   2. state regulations, with minimum but coordinated federal regulations..... H A L ?
   3. laws to stop all pollution and erosion into the marine environment..... H A L ?

H. Further study:
   1. a need to:
      a. further understand and use marine resources..... H A L ?
      b. educate everyone in the proper use of the aquatic environment..... H A L ?
      c. learn more about marine geography..... H A L ?
      d. develop more marine oriented programs in all our state schools from the primary grades to the graduate level..... H A L ?

I. Aesthetics.
   1. love of:
      a. the beauty of marine and estuarine environments..... H A L ?
      b. marine life..... H A L ?
      c. marine literature (like The Sea Wolf)..... H A L ?
   2. a need to visit:
      a. a maritime museum..... H A L ?
      b. a U.S. port or merchant vessel..... H A L ?
      c. the Naval Museum, or a Navy ship..... H A L ?

VIMS-SEA GRANT
MARINE EDUCATION SURVEY
SECOND ROUND
"E" SECTION

Please circle the letter corresponding to the priority you feel should be assigned to each objective.

Return completed form to:
J. Lanier
VIMS
Gloucester Pt., VA 23062

I. A Virginia high school graduate should know:

	High	Average	Low	Don't Understand
A. General marine science. The significance/relationship/ importance of the marine environment to the total environment.....	H	A	L	?
B. Life in the water.				
1. the names of animals and plants common to the Virginia coastal system.....	H	A	L	?
2. in general terms, a typical marine food web (in relation to trophic levels, food energy pyramids, and nutrient flow).....	H	A	L	?
3. the importance of:				
a. wetlands.....	H	A	L	?
b. bays.....	H	A	L	?
c. rivers.....	H	A	L	?
4. that there is interaction between chemical and physical factors in the water and the marine life it contains.....	H	A	L	?
C. The ocean floor and shore.				
1. the causes of erosion.....	H	A	L	?
2. effects of erosion.....	H	A	L	?

3. effects of groins on beaches.....	H	A	L	?
D. Geography. Names and locations of:				
1. all tributaries to Chesapeake Bay.....	H	A	L	?
2. counties and cities on the Bay and its tributaries....	H	A	L	?
3. the principal oceans and seas.....	H	A	L	?
II. A Virginia high school graduate should be able to:				
A. Boating.				
1. handle small craft.....	H	A	L	?
2. prepare engines and boat equipment.....	H	A	L	?
B. Swimming.				
1. swim 100 yards.....	H	A	L	?
2. be able to sustain one's self in the water under adverse conditions.....	H	A	L	?
C. Safety.				
1. practice water safety.....	H	A	L	?
2. assist others in the water.....	H	A	L	?
D. General.				
1. fish.....	H	A	L	?
2. treat waterfowl endangered by oil pollution.....	H	A	L	?
3. recognize environmentally detrimental conditions.....	H	A	L	?
4. identify:				
a. different types of watercraft.....	H	A	L	?
b. national flags of visiting vessels.....	H	A	L	?
5. perform minor construction to preserve or enhance the marine environment, such as:				
a. drainage.....	H	A	L	?
b. fill.....	H	A	L	?
c. bulkheading.....	H	A	L	?

d. dune stabilization.....	H	A	L	?
e. erosion control.....	H	A	L	?

III. A Virginia high school graduate should feel:

A. General.

1. appreciation for:				
a. the emotional importance of water areas.....	H	A	L	?
b. conservation of fish and other wildlife.....	H	A	L	?
c. Virginia's marine resources (including her coast).	H	A	L	?
d. the effect of contiguous land areas on our marine environment.....	H	A	L	?
2. respect for:				
a. the water.....	H	A	L	?
b. others using public waters.....	H	A	L	?
c. the forces of the marine environment.....	H	A	L	?
3. anti-litter along coast as well as from boats.....	H	A	L	?
4. love of the water.....	H	A	L	?
5. that there are job opportunities.....	H	A	L	?

B. Our place in the ecosystem.

1. that man's survival is linked to the condition of the ocean and its resources.....	H	A	L	?
2. a kinship to all forms of marine life and a desire to learn from them.....	H	A	L	?

C. Stewardship.

1. protective of:				
a. marine resources.....	H	A	L	?
b. the marine environment.....	H	A	L	?
2. a feeling of personal importance to the effort to preserve the marine environment for future generations	H	A	L	?

D. Balance and priorities.				
1. that there should be a balance between resource development and habitat preservation.....	H	A	L	?
2. an appreciation of the diversity of coastal users and the need for compromises between different interests..	H	A	L	?
3. that there is more than one solution to a problem.....	H	A	L	?
4. a need to preserve the proper balance of nature.....	H	A	L	?
E. Management. The need for:				
1. more coastal zone management.....	H	A	L	?
2. planning.....	H	A	L	?
3. development.....	H	A	L	?
F. Marine science.				
1. that marine science:				
a. will contribute to national well being.....	H	A	L	?
b. will result in an efficient selection of programs which will make possible the wise use of marine resources.....	H	A	L	?
c. is a logical career choice in Virginia.....	H	A	L	?
d. can be rewarding and satisfying to the student....	H	A	L	?
2. a desire to learn more about the marine environment...	H	A	L	?

VIMS-SEA GRANT
MARINE EDUCATION SURVEY
SECOND ROUND
"F" SECTION

Please circle the letter corresponding to the priority you feel should be assigned to each objective.

Return completed form to:
Jim Lanier
VIMS
Gloucester Pt., VA 23062

I. A Virginia high school graduate should know:

	High	Average	Low	Don't Understand
A. General marine science.				
1. the definition of:				
a. ocean	H	A	L	?
b. estuary	H	A	L	?
c. freshwater	H	A	L	?
d. wetlands	H	A	L	?
e. oceanography or marine science (composite of natural sciences, not all bikinis and scuba)	H	A	L	?
f. barrier island	H	A	L	?
g. marine environment	H	A	L	?
h. marine resources	H	A	L	?
2. the importance of:				
a. wetlands	H	A	L	?
b. estuaries	H	A	L	?
c. the marine environment	H	A	L	?
3. the significance/relationship/importance of the marine environment to the total environment	H	A	L	?
4. factors that influence the marine environment in Virginia (positive and negative)	H	A	L	?
5. the amount of saltwater in the world, and its effects on freshwater	H	A	L	?

6. the effects of excessive amounts of freshwater on estuarine environments.....	H	A	L	?
7. about tidal cycles, and their benefits to man and nature.....	H	A	L	?
8. the differences in tidal ranges, salinity and biology between the ocean and the upper reaches of Virginia's rivers.....	H	A	L	?
9. just how giving and taking "Old Man Sea" can be.....	H	A	L	?
B. Life in the water.				
1. the names of animals and plants common to the Virginia coastal system, including:				
a. marine animals and plants.....	H	A	L	?
b. finfishes.....	H	A	L	?
c. five important commercial species.....	H	A	L	?
2. the life histories of the:				
a. oyster.....	H	A	L	?
b. shellfishes of Virginia.....	H	A	L	?
c. blue crab.....	H	A	L	?
d. finfishes.....	H	A	L	?
e. marine animals and plants.....	H	A	L	?
3. regarding marine plants and animals:				
a. which are harmful.....	H	A	L	?
b. physical characteristics affecting their distribution.....	H	A	L	?
4. Bay fish:				
a. habitats.....	H	A	L	?
b. seasons.....	H	A	L	?
c. migrations.....	H	A	L	?
5. in general terms, a typical marine food web (in relation to trophic levels, food energy pyramids, and nutrient flow).....	H	A	L	?
6. understand the "nursery" role of tidal marshes and estuaries.....	H	A	L	?

7. that marine life is most abundant in the coastal zone and over the continental shelves.....	H	A	L	?
8. the density of life in the sea as compared with dry land.....	H	A	L	?
9. the relationships of marine plants and animals to each other.....	H	A	L	?
10. the effects of freshwater on the Bay and its inhabitants.....	H	A	L	?
11. that stinging nettles cannot be eradicated from the Bay.....	H	A	L	?
12. that eelgrass beds are the boreal counterpart of coral reefs.....	H	A	L	?
C. The ocean floor and shore.				
1. the geometry of the world ocean, including:				
a. bathymetry.....	H	A	L	?
b. geomorphology of Chesapeake Bay.....	H	A	L	?
2. theories on the formation of:				
a. rivers.....	H	A	L	?
b. bays.....	H	A	L	?
c. marshes.....	H	A	L	?
d. coastal areas.....	H	A	L	?
3. the effects of sedimentation and erosion on the marine environment and its resources.....	H	A	L	?
4. the effects of waves on shorelines.....	H	A	L	?
5. the difficulty of controlling beach erosion with manmade structures and why.....	H	A	L	?
D. Geography.				
1. the names and locations of:				
a. all tributaries to the Chesapeake Bay.....	H	A	L	?
b. counties and cities on the Bay and its tributaries	H	A	L	?
c. the principal oceans and seas.....	H	A	L	?
2. boundaries of tidal waters and fall lines.....	H	A	L	?
3. the total extent of the Virginia shoreline; including				

	seashore, lakes and rivers.....	H	A	L	?
4.	how to read charts.....	H	A	L	?
E.	How water moves. causes of, and characteristics of:				
1.	waves.....	H	A	L	?
2.	tides (including effects of sun and moon, spring and neap tides).....	H	A	L	?
3.	currents.....	H	A	L	?
4.	complex movements.....	H	A	L	?
F.	Weather.				
1.	the mechanism of heat transfer from the equator to the poles through ocean currents, and the consequent influence on weather and climate.....	H	A	L	?
2.	the characteristics of ocean tropical storms (hurricanes and typhoons).....	H	A	L	?
3.	how to interpret weather forecasts.....	H	A	L	?
4.	the influence of weather on the Chesapeake Bay.....	H	A	L	?
G.	The nature of water.				
1.	physical and chemical properties of fresh, estuarine and seawater.....	H	A	L	?
2.	theories on the origin of sea water.....	H	A	L	?
H.	The influence of water on our history.				
1.	historic uses of marine resources.....	H	A	L	?
2.	the ways these uses have affected people and the environment.....	H	A	L	?
3.	the influence of Chesapeake Bay history on our society, including:				
a.	archaeology.....	H	A	L	?
b.	role in colonial development.....	H	A	L	?
c.	sea trade.....	H	A	L	?
d.	sea power.....	H	A	L	?
4.	the importance of Virginia's waterways in the				

development of our communities and vice-versa.....	H	A	L	?
5. the future of the world's ocean and its impact on Virginia.....	H	A	L	?
I. Economics.				
1. general				
a. current commercial uses of the marine environment.	H	A	L	?
b. relative impact on the Virginia economy of:				
(1) commercial fishing.....	H	A	L	?
(2) crabs.....	H	A	L	?
(3) maritime terminal and support operations.....	H	A	L	?
(4) the Chesapeake Bay.....	H	A	L	?
(5) the total marine environment.....	H	A	L	?
c. the potential for:				
(1) development and use of new marine technology.	H	A	L	?
(2) new medical products from the sea.....	H	A	L	?
(3) energy from the sea.....	H	A	L	?
d. principles of hydroelectric power.....	H	A	L	?
2. fishing				
a. Virginia's chief commercial seafood products.....	H	A	L	?
b. the following about seafood harvested in Virginia:				
(1) how harvested.....	H	A	L	?
(2) how eaten.....	H	A	L	?
(3) dollar value.....	H	A	L	?
(4) nutritional value.....	H	A	L	?
(5) the great amount produced.....	H	A	L	?
(6) effect on the lives and economy of Virginians	H	A	L	?
c. the annual value and size of catch of:				
(1) oysters.....	H	A	L	?
(2) menhaden.....	H	A	L	?
(3) crabs.....	H	A	L	?
(4) scallops.....	H	A	L	?
(5) shrimp.....	H	A	L	?

d. the importance of the Virginia seafood industry as a source of employment.....	H	A	L	?
e. major fishing areas of the state.....	H	A	L	?
f. history of aquaculture.....	H	A	L	?
g. aquaculture potential (animal or plant).....	H	A	L	?
3. transportation				
a. the importance of the following to Virginia:				
(1) marine carriers.....	H	A	L	?
(2) shipyards.....	H	A	L	?
(3) U.S. Navy facilities.....	H	A	L	?
(4) the port of Hampton Roads.....	H	A	L	?
b. the kinds of goods currently imported and exported from Virginia by sea.....	H	A	L	?
c. rules of the road.....	H	A	L	?
d. navigation signs and symbols.....	H	A	L	?
e. weather rules for safe boating.....	H	A	L	?
f. Coast Guard licensing requirements.....	H	A	L	?
4. recreation and leisure uses of waterways.....	H	A	L	?
5. employment				
a. about marine careers and the futures they offer...	H	A	L	?
b. that marine resource utilization requires a variety of manpower (appropriately educated and trained) and community commitment.....	H	A	L	?
c. major climatic characteristics of the "northern" and "southern" regions of the Bay with attention to the variety of occupations.....	H	A	L	?
J. Environmental problems.				
1. the impact of the following on the marine environment and man:				
a. man-made structures.....	H	A	L	?
b. water pollution.....	H	A	L	?
c. overdevelopment.....	H	A	L	?
d. coastal oil refineries.....	H	A	L	?

e. overfishing	H	A	L	?
f. crab dredging	H	A	L	?
g. menhaden fishing	H	A	L	?
h. hand seining	H	A	L	?
i. shellfishing	H	A	L	?
j. hurricanes	H	A	L	?
k. water - spouts	H	A	L	?
l. long term temperature variations	H	A	L	?
m. redistribution of marine resources	H	A	L	?
n. introduciton of exotic species	H	A	L	?
o. cooling of nuclear power plants	H	A	L	?
p. channelization	H	A	L	?
q. sewage	H	A	L	?
r. chemical dumping	H	A	L	?
s. building on wetlands	H	A	L	?
t. boat wakes	H	A	L	?
2. the fragile nature of the marine environment	H	A	L	?
3. regarding water pollution:				
a. causes	H	A	L	?
b. types	H	A	L	?
c. effects	H	A	L	?
d. clean up methods	H	A	L	?
4. that the Gloucester Point area has lost many of its marine animals	H	A	L	?
5. about people's efforts to counteract environmental problems	H	A	L	?
I. Regulation and management.				
1. laws and procedures governing:				
a. water pollution	H	A	L	?
b. environmental control	H	A	L	?
c. fishing	H	A	L	?
d. shellfishing	H	A	L	?

2. about regulatory agencies which protect the marine environment, including:
   a. names..... H A L ?
   b. functions..... H A L ?
   c. personnel..... H A L ?
3. the benefits of marine environmental protection and resource planning..... H A L ?

II. A Virginia high school graduate should be able to:

A. General.
   1. take samples with:
      a. seine..... H A L ?
      b. gill net..... H A L ?
      c. dip net..... H A L ?
      d. dredge..... H A L ?
      e. corer..... H A L ?
   2. treat waterfowl endangered by oil pollution..... H A L ?
   3. make potable water..... H A L ?
   4. shovel beach sand..... H A L ?
   5. set up and maintain a marine aquarium..... H A L ?
   6. measure:
      a. temperature..... H A L ?
      b. salinity..... H A L ?
      c. currents..... H A L ?
      d. dissolved oxygen (DO)..... H A L ?
      e. biochemical oxygen demand (BOD)..... H A L ?
      f. tides..... H A L ?
      g. volumes of seawater..... H A L ?
      h. pH..... H A L ?
   7. conduct elementary laboratory tests identifying water pollutants..... H A L ?

B. Life in the water.
   1. identify:
      a. common marine animals..... H A L ?

b. common marine plants	H	A	L	?
c. 25 aquatic marine plant and animal specimens	H	A	L	?
2. quantify populations of aquatic species	H	A	L	?
C. Weather.				
1. identify storm, gale or hurricane flag warnings	H	A	L	?
2. read in-coming weather	H	A	L	?
D. Fishing and seafood.				
1. fish for the following:				
a. finfishes	H	A	L	?
b. shellfishes	H	A	L	?
2. open, clean, and/or prepare:				
a. crabs	H	A	L	?
b. oysters	H	A	L	?
c. clams	H	A	L	?
d. catfish	H	A	L	?
e. rabbitfish	H	A	L	?
3. process and store seafood	H	A	L	?
E. Boating.				
1. row	H	A	L	?
2. paddle	H	A	L	?
3. sail	H	A	L	?
4. handle small power boat	H	A	L	?
5. handle boating emergencies and bad weather	H	A	L	?
6. work on marine engines	H	A	L	?
7. demonstrate basic safety rules for small boats including:				
a. refueling	H	A	L	?
b. loading and unloading	H	A	L	?
c. what to do in case of fire	H	A	L	?
d. righting a small craft	H	A	L	?
8. use marine communications	H	A	L	?
9. navigate	H	A	L	?
10. water ski safely	H	A	L	?

F. Swimming and diving.
1. pass the Red Cross Beginners' Swimming Test.
2. swim:
a. 25 yards..... H A L ?
b. 50 yards..... H A L ?
c. 100 yards..... H A L ?
d. 200 yards..... H A L ?
3. stay afloat:
a. 10 minutes..... H A L ?
b. 20 minutes..... H A L ?
c. 30 minutes..... H A L ?
d. 10 hours, with life vest..... H A L ?
4. be drown-proof..... H A L ?
5. hold breath underwater..... H A L ?
6. use mask, snorkel, and flippers..... H A L ?
7. SCUBA dive..... H A L ?

G. Safety.
1. properly use water safety equipment..... H A L ?
2. rescue someone in trouble in the water..... H A L ?
3. survive in emergency situations that occur when the environment turns hostile..... H A L ?
4. administer first aid for:
a. burns..... H A L ?
b. cuts..... H A L ?
c. shock..... H A L ?
d. drowning..... H A L ?

III. A Virginia high school graduate should feel:

A. General.
1. appreciation for:
a. Virginia's marine resources..... H A L ?
b. the complexity and delicacy of Virginia's coastal ecosystem..... H A L ?
c. the power, size, complexity and central ecological role

	of the oceans	H	A	L	?
d.	the strategic value of the sea	H	A	L	?
e.	the diversity of marine life	H	A	L	?
f.	all marine species, not just commercially valuable ones	H	A	L	?
g.	the commerical and recreational importance of Chesapeake Bay	H	A	L	?
h.	the value of wetlands	H	A	L	?
i.	the sea as the cradle of life	H	A	L	?
j.	God's gift of our magnificent marine world	H	A	L	?
k.	the role of Bay shipwrights in building revolutionary warships	H	A	L	?
l.	our beaches and other recreational opportunities	H	A	L	?
2.	respect for:				
a.	the water	H	A	L	?
b.	others using public waters	H	A	L	?
c.	the hazards associated with the marine environment	H	A	L	?
d.	storms on the water	H	A	L	?
e.	equipment of others (such as crab pots)	H	A	L	?
3.	aware of:				
a.	man's multifaceted impact on the marine system	H	A	L	?
b.	the instability of some "man influenced" marine habitats.	H	A	L	?
c.	the effects of the marine environment on each person as an individual	H	A	L	?
d.	the processes and technology involved in a scientific study - the productivity of the oceanographer	H	A	L	?
4.	a desire to improve public awareness of our coastal area resources	H	A	L	?
5.	that the marine environment is an integral part of Virginia	H	A	L	?
6.	a kinship with and pride in the rich maritime history of Virginia	H	A	L	?
7.	secure and relaxed around the water	H	A	L	?
8.	unashamed to be courteous and obey the rules of the road at all times	H	A	L	?
9.	that more powerful boat engines are not necessarily better	H	A	L	?
10.	comfortable in dealing with watermen	H	A	L	?

11.	that man is a part of the marine environment, not the owner..	H	A	L	?
12.	comfortable in discussing or reading material on marine environments - to the point of knowledgeable testimony in public hearings, etc.....	H	A	L	?
13.	education should not create attitudes - that is called "brainwashing". Education should be directed toward creating a logical thought process and providing information to consider or the knowledge of how to find information.....	agree		disagree	

B. Stewardship.

1.	protective of:				
	a. marine resources.....	H	A	L	?
	b. the marine environment.....	H	A	L	?
	c. marine animals.....	H	A	L	?
	d. spawning marine animals.....	H	A	L	?
	e. clean water.....	H	A	L	?
	f. wetlands.....	H	A	L	?
2.	that the marine environment is fragile and perhaps non-renewable.....	H	A	L	?
3.	that the marine environment is a fertile area not to be used as a dump.....	H	A	L	?
4.	less of a desire to own waterfront for selfish purposes.....	H	A	L	?
5.	that more salt grasses should be saved/planted to stop shoreline loss.....	H	A	L	?

C. Balance and priorities.

1.	that there should be a balance between:				
	a. resource development and habitat preservation.....	H	A	L	?
	b. public welfare and the environment.....	H	A	L	?
	c. public welfare and private ownership.....	H	A	L	?
	d. the future and immediate economic gain.....	H	A	L	?
	e. access by the public and pristine waters.....	H	A	L	?
	f. enjoyment of sport fishing and greedy exploitation.....	H	A	L	?
2.	that there are not enough public access places to put a boat in the water.....	H	A	L	?

D. Economics.
   1. the economic importance of:
      a. marine resources..... H A L ?
      b. marine life..... H A L ?
      c. energy from the sea..... H A L ?
   2. the need to develop our marine resources..... H A L ?

E. Seafood.
   1. the importance of the seafood industry to our future..... H A L ?
   2. that fishing (commercial and/or recreational) is a legitimate use of marine resources when effectively managed, and is not detrimental to the resource..... H A L ?

F. Environmental problems.
   1. the need:
      a. to maintain Virginia waters practically pollution free... H A L ?
      b. to avoid future pollution and reduce present pollution... H A L ?
      c. for anti-pollution measures..... H A L ?
   2. an active interest in how to prevent such destructive forces as oil spills, chemical spills, etc..... H A L ?
   3. that pollution of estuaries will ultimately destroy the marine environment..... H A L ?

G. Management. the need for:
   1. resource management..... H A L ?
   2. laws and law enforcement officials to protect the marine environment..... H A L ?
   3. an attitude of cooperation between adjoining political entities..... H A L ?

H. Further study. the need for:
   1. high school teachers to learn more marine ecology and appreciate its importance in the public school system..... H A L ?
   2. the state to provide scholarships to working teachers for marine studies..... H A L ?

I. Aesthetics.

1. love of:
   a. the beauty of marine and estuarine environments..... H A L ?
   b. the beauty of wetlands..... H A L ?
   c. the water..... H A L ?
   d. the part water plays in our environment and way of life.. H A L ?
2. that water can be the scene of "calm excitement" rather than simply a place for racing around in faster and faster boats.. H A L ?

Cover Letter

for

Third Delphi Questionnaire

COLLEGE OF WILLIAM AND MARY
VIRGINIA INSTITUTE OF MARINE SCIENCE
SCHOOL OF MARINE SCIENCE
Gloucester Point, Virginia 23062
Phone (804) 642-2111

CHARTERED 1693

SEA GRANT PROGRAM

May 23, 1980

Dear Friend of Marine Education:

Thank you for your response to the second round of our Marine Education Survey. Of the 361 of you who had agreed to participate, 235 returned questionnaires in that round, or 65%. Again I ask that those who were unable to respond last time, do so this time.

The questionnaire for round three is a compilation of every objective from all six sections which was given a high priority by a majority of those who rated it. If an objective which you support strongly was deleted, I encourage you to slip me a note with your response. Let me know which objective you think should still be included and why.

We will use a response sheet in this round which will be scored by computer. You will find a separate sheet attached to each of the three sections. Please use only the sheet attached to the section for that section.

Please use only a number 2 (soft lead) pencil, and place marks only in the answer columns (place no marks in the shaded top portion of the sheets). Marking "A" will indicate that you believe the objective with that number on your questionnaire should be taught if at all possible; "B", that it should be taught if convenient, but does not warrant special effort; "C" that this objective should not be included in our precollege educational system; and "D", that you do not understand the objective.

For those items calling for an "Agree" or "Disagree" answer, mark "A" for "agree" and "B" for "disagree"! Leave the "E" column blank.

As many of you know, this is my last project for VIMS. The very capable staff I am leaving at VIMS will continue to help educators across the Old Dominion in achieving the objectives you have helped formulate.

My interest in marine education will continue in my new job as Director of Educational Programs for the New Jersey Marine Sciences Consortium. I would welcome hearing from any of you at:

N.J. Marine Sciences Consortium
101 College Road East
Princeton, NJ 08540
(609) 452-8465

I will continue to work through the Sea Grant Program at VIMS in supplying you with feedback from this survey.

Please return your computer sheets within one week of receiving them.

Thank you again for your help.

Sincerely,

JAL:jah

cc: Committee
Dr. Bob Ellis

James A. Lanier
Head
Marine Education Section

Third Delphi Questionnaire

VIMS-SEA GRANT
MARINE EDUCATION SURVEY
THIRD ROUND
CONSOLIDATED QUESTIONNAIRE

Please use the enclosed computer-scored sheet to indicate ratings. Mark "A" for "High", "B" for "Average", "C" for "Low" and "D" for "Don't Understand." Use "A" for "Agree" and "B" for "Disagree."

Return completed computer-scored sheet to
J. Lanier
VIMS
Gloucester Pt., VA 23062

(You may keep this form for your records.)

I. A Virginia high school graduate should know:

	A High	B Average	C Low	D Don't Understand
A. General marine science.				
1. that the ocean contains not only living organisms, but is a physical, chemical and geologic system.....	H	A	L	?
2. the definition of oceans.....	H	A	L	?
3. the definition of estuaries.....	H	A	L	?
4. the definition of fresh water.....	H	A	L	?
5. the definition of wetlands.....	H	A	L	?
6. how oceans, estuaries, freshwater and wetlands are alike (and different) biologically.....	H	A	L	?
7. how oceans, estuaries, freshwater and wetlands are alike (and different) geologically.....	H	A	L	?
8. why the bay is productive.....	H	A	L	?
9. the significance/relationship/importance of the marine environment to the total environment.....	H	A	L	?
10. the "real" meaning of the term ecology.....	H	A	L	?
11. that despite its size and apparently limitless nature, the marine environment is a collection of ecosystems with the same basic characteristics, constraints, limits, and susceptibility to perturbation as terrestrial ecosystems.....	H	A	L	?
12. what the hydrosphere is.....	H	A	L	?

13.	the definition of oceanography or marine science (composite of natural sciences, <u>not</u> all bikinis and scuba).....	H	A	L	?
14.	the definition of barrier island.....	H	A	L	?
15.	the definition of marine environment.....	H	A	L	?
16.	the definition of marine resources.....	H	A	L	?
17.	the importance of estuaries.....	H	A	L	?
18.	the importance of wetlands.....	H	A	L	?
19.	the importance of bays.....	H	A	L	?
20.	the importance of rivers.....	H	A	L	?
21.	the importance of the marine environment.....	H	A	L	?
22.	that there is interaction between chemical and physical factors in the water and the marine life it contains.....	H	A	L	?
23.	factors that influence the marine environment in Virginia (positive and negative).....	H	A	L	?
24.	about tidal cycles, and their benefits to man and nature.....	H	A	L	?
B. Life in the water.					
25.	how to recognize edible & endangered species living in local waters.....	H	A	L	?
26.	the habitat, season, and migration of common food and game fishes of this area.....	H	A	L	?
27.	the importance of clean water to the health and spawning of fishes.....	H	A	L	?
28.	the fragile nature of the marine ecosystem.....	H	A	L	?
29.	that marine life is most abundant in the coastal zone and over the continental shelves.....	H	A	L	?
30.	in general terms, a typical food web (in relation to trophic levels, food energy pyramids and nutrient flow) in the ocean.....	H	A	L	?
31.	in general terms, a typical food web (in relation to trophic levels, food energy pyramids and nutrient flow) in the estuary.....	H	A	L	?
32.	the life histories of important commercial species in local waters.....	H	A	L	?

33. the ecological factors that make Virginia waters unique.....	H	A	L	?
34. what feeds aquatic life.....	H	A	L	?
35. what kills aquatic life.....	H	A	L	?
36. understand the "nursery" role of tidal marshes and estuaries.....	H	A	L	?
C. The ocean floor and shore.				
37. the theory of plate tectonics (or continental drift)..	H	A	L	?
38. the effects of waves on shorelines.....	H	A	L	?
39. the difficulty of controlling beach erosion with manmade structures and why.....	H	A	L	?
40. the effects of sedimentation and erosion on the marine environment and its resources.....	H	A	L	?
41. the effects of waves on shorelines.....	H	A	L	?
D. Geography.				
42. the names and locations of the principal oceans and seas.....	H	A	L	?
43. that the earth's surface is more than 70% water.....	H	A	L	?
E. How water moves.				
44. causes of, and characteristics of tides (including effects of sun and moon, spring and neap tides).....	H	A	L	?
45. causes of, and characteristics of currents.....	H	A	L	?
46. that the ocean is part of a coupled fluid system (ocean/atmosphere).....	H	A	L	?
F. Weather.				
47. the effect of large bodies of water on weather and climate.....	H	A	L	?
48. how to interpret weather forecasts.....	H	A	L	?
G. The influence of water on our history.				
49. the importance of the marine environment in U.S. history.....	H	A	L	?

50.	the importance of Virginia's waterways in the development of our communities and vice-versa.....	H	A	L	?
51.	the influence of Chesapeake Bay history on our society, including settlement and development.....	H	A	L	?
52.	the future of the world's ocean and its impact on Virginia.....	H	A	L	?
H. Economics.					
53.	current commercial uses of the marine environment.....	H	A	L	?
54.	relative impact on Virginia economy of marine recreation (boating, fishing, hunting, etc.).....	H	A	L	?
55.	relative impact on Virginia economy of commerce vs pleasure.....	H	A	L	?
56.	how many people depend on the water for their livelihood.....	H	A	L	?
57.	relative impact on the Virginia economy of commercial fishing.....	H	A	L	?
58.	current commercial uses of the marine environment.....	H	A	L	?
59.	the causes and effects of economic pressures on Virginia's coast.....	H	A	L	?
60.	Virginia's chief commercial seafood products.....	H	A	L	?
61.	the potential and actual energy resources of the ocean.....	H	A	L	?
62.	the current and historic effect of the marine environment on the state's economic development.....	H	A	L	?
63.	outdated methods used to harvest seafood.....	H	A	L	?
64.	effect of seafood harvested in Virginia on employment in entire state.....	H	A	L	?
65.	importance of food value of seafood harvested in Virginia to the nation.....	H	A	L	?
66.	the potential for producing more seafood.....	H	A	L	?
67.	setbacks that plague shellfish such as oysters, clams, crabs, and scallops.....	H	A	L	?
68.	relative impact on the Virginia economy of waste disposal.....	H	A	L	?
69.	relative impact on the Virginia economy of shipbuilding and repair.....	H	A	L	?

70.	the potential of the oceans as a source of minerals.....	H	A	L	?
71.	the potential of the oceans as a source of fresh water.....	H	A	L	?
72.	the meaning of the expression "merchant marine" and the general nature of the shipping business.....	H	A	L	?
73.	the importance of ocean shipping to the availability of critical resources such as oil, tin, chrome, etc...	H	A	L	?
I.	Environmental problems.				
74.	that people can destroy in a few days what it will take years to replace.....	H	A	L	?
75.	how to prevent water pollution.....	H	A	L	?
76.	the effects of natural pollutants.....	H	A	L	?
77.	the effects of man-made pollutants.....	H	A	L	?
78.	the effects of point sources of water pollution (sewage and industrial outfalls, etc).....	H	A	L	?
79.	the effects of destruction of estuaries.....	H	A	L	?
80.	the effects of littering.....	H	A	L	?
81.	the effects of a "dead", polluted Chesapeake Bay.....	H	A	L	?
82.	the effects of upland development on estuarine water quality and wildlife.....	H	A	L	?
83.	the effects of destruction of one part of the environment on the remaining parts.....	H	A	L	?
84.	what actions have an adverse impact on the shellfish industry.....	H	A	L	?
85.	those portions of the system which appear most vulnerable to disturbance.....	H	A	L	?
86.	the benefits the Bay provides to Virginia, in order of their probable vulnerability to pollution....	H	A	L	?
87.	the rate at which wetlands are being destroyed.....	H	A	L	?
88.	harmful aspects of the marine environment.....	H	A	L	?
89.	enough to write a brief essay describing the effects of some specific water pollutant on some specific organism in the Bay.....	H	A	L	?
90.	the impact of sewage discharges.....	H	A	L	?
91.	the impact of too many nutrients.....	H	A	L	?

92.	the impact of dredging and spoil disposal.....	H	A	L	?
93.	the impact of oil spills.....	H	A	L	?
94.	the impact of chemicals used by farmers, industry, etc.....	H	A	L	?
95.	the impact of bulkheads and piers on marshes.....	H	A	L	?
96.	the impact of overdevelopment.....	H	A	L	?
97.	the impact of overfishing.....	H	A	L	?
98.	the impact of destruction of wetlands.....	H	A	L	?
99.	the impact of abuse of recreation facilities.....	H	A	L	?
100.	the destructive effects of marine corrosion.....	H	A	L	?
101.	why the ocean is dying.....	H	A	L	?
102.	the impact of man-made structures.....	H	A	L	?
103.	the impact of coastal oil refineries.....	H	A	L	?
104.	the impact of chemical dumping.....	H	A	L	?
105.	causes of water pollution.....	H	A	L	?
106.	types of water pollution.....	H	A	L	?
107.	clean up methods for water pollution.....	H	A	L	?
J.	Regulation and management.				
108.	laws and procedures governing oil spills.....	H	A	L	?
109.	laws and procedures governing water pollution.....	H	A	L	?
110.	the benefits of marine environmental protection and resource planning.....	H	A	L	?
K.	Defense.				
111.	the importance of seapower in geopolitics.....	H	A	L	?
112.	the role of the Navy in national defense, particularly that of ensuring freedom of the seas and the availability of resources in which we are not self-sufficient.....	H	A	L	?
L.	Safety.				
113.	rules for navigation and water safety.....	H	A	L	?
114.	what marine life should not be eaten.....	H	A	L	?
115.	safety procedures and equipment needed on vessels.....	H	A	L	?
116.	the dangers of being on the water in a wind or electrical storm.....	H	A	L	?

117.	safety rules for swimming.....	H	A	L	?
118.	basic weather warnings.....	H	A	L	?

L. Miscellaneous.

119.	A+B+C+D = global role of world ocean in the continued existence of spaceship earth.....	H	A	L	?

II. A Virginia high school graduate should be able to:

A. General oceanographic skills.

1. visit an intertidal area and leave it undisturbed.....	H	A	L	?
2. recognize environmentally detrimental conditions.....	H	A	L	?

B. Geography.

3. read maps, charts, graphs, etc. which present data on the marine environment, resources, geography, etc...	H	A	L	?

C. Weather.

4. read and interpret weather signs.....	H	A	L	?
5. identify storm, gale or hurricane flag warnings.....	H	A	L	?

D. Boating.

6. row.....	H	A	L	?
7. demonstrate basic safety rules for small boats including what to do in case of fire on a boat.....	H	A	L	?
8. demonstrate how to right a small craft.....	H	A	L	?

E. Swimming and diving.

9. swim 25 yards.....	H	A	L	?
10. swim 50 yards.....	H	A	L	?
11. swim 100 feet.....	H	A	L	?
12. swim 100 yards.....	H	A	L	?
13. swim sufficiently to cope in water accidents.....	H	A	L	?
14. swim to pool's edge, after removing shoes, coats, etc.....	H	A	L	?
15. stay afloat for one hour fully clothed and without aids.....	H	A	L	?
16. deal with immersion.....	H	A	L	?
17. be able to sustain one's self in the water under adverse conditions.....	H	A	L	?
18. pass the Red Cross Beginners' Swimming Test.....	H	A	L	?
19. float.....	H	A	L	?
20. stay afloat 10 minutes.....	H	A	L	?
21. stay afloat 20 minutes.....	H	A	L	?

22.	stay afloat 30 minutes in deep water.....	H	A	L	?
23.	stay afloat 10 hours with life vest.....	H	A	L	?
24.	be drown-proof.....	H	A	L	?
25.	hold breath underwater.....	H	A	L	?
F. Safety.					
26.	perform CPR.....	H	A	L	?
27.	perform drownproofing skills.....	H	A	L	?
28.	use a personal floatation device (life jacket).....	H	A	L	?
29.	recognize potential dangers on and in the water.....	H	A	L	?
30.	perform basic first aid.....	H	A	L	?
31.	use a ring buoy.....	H	A	L	?
32.	use clothing as preservers.....	H	A	L	?
33.	perform life saving.....	H	A	L	?
34.	perform survival techniques.....	H	A	L	?
35.	survive in a potential drowning situation.....	H	A	L	?
36.	practice water safety.....	H	A	L	?
37.	assist others in the water.....	H	A	L	?
38.	properly use water safety equipment.....	H	A	L	?
39.	survive in emergency situations that occur when the environment turns hostile.....	H	A	L	?
40.	administer first aid for burns.....	H	A	L	?
41.	administer first aid for cuts.....	H	A	L	?
42.	administer first aid for shock.....	H	A	L	?
43.	administer first aid for drowning.....	H	A	L	?
G. Miscellaneous.					
44.	I believe that at the High School level, basic knowledge and appreciation should be stressed. Specific skills should be gained later in college, trade school, apprentice ships, OJT, etc.....	agree		disagree	

III. A Virginia high school graduate should feel:

A. General.

1.	appreciation for Virginia's marine resources (including her coast).....	H	A	L	?
2.	appreciation for wetland animals.....	H	A	L	?
3.	appreciation for wetland plants.....	H	A	L	?
4.	appreciation for the value of wetlands.....	H	A	L	?
5.	appreciation for the importance of fishes and shellfishes.....	H	A	L	?
6.	appreciation for the quality of Virginia waters and marine life.....	H	A	L	?
7.	appreciation for the complexity and delicacy of Virginia's coastal ecosystem.....	H	A	L	?
8.	appreciation for the power, size, complexity, and central ecological role of the oceans.....	H	A	L	?
9.	appreciation for the power and inevitability of hurricanes and littoral drift.....	H	A	L	?
10.	appreciation for conservation of fish and other wildlife.....	H	A	L	?
11.	appreciation for the effect of contiguous land areas on our marine environment.....	H	A	L	?
12.	appreciation for the complexity and delicacy of Virginia's coastal ecosystem.....	H	A	L	?
13.	appreciation for the commercial and recreational importance of Chesapeake Bay.....	H	A	L	?
14.	appreciation for the sea as the cradle of life.....	H	A	L	?
15.	respect for the water.....	H	A	L	?
16.	respect for others using public waters.....	H	A	L	?
17.	respect for all sea life.....	H	A	L	?
18.	respect for the support of the marine environment and culture.....	H	A	L	?
19.	respect for equipment of others (such as crab pots)....	H	A	L	?
20.	respect for storms on the water.....	H	A	L	?
21.	respect for floods.....	H	A	L	?
22.	respect for the forces of the marine environment.....	H	A	L	?

23.	anti-litter along coast as well as from boats.....	H	A	L	?
24.	secure and relaxed around the water.....	H	A	L	?
25.	resentment at destructive activities.....	H	A	L	?
26.	motivated to help others in an emergency.....	H	A	L	?
27.	a responsibility for our environment.....	H	A	L	?
28.	that Virginia is tops in seafood on the east coast and that there are none better in the world than the Chesapeake Bay oyster.....	H	A	L	?
29.	secure and relaxed around the water.....	H	A	L	?
30.	respect for the hazards associated with the marine environment.....	H	A	L	?
31.	that there are job opportunities.....	H	A	L	?
32.	that the marine environment is an integral part of Virginia.....	H	A	L	?
33.	unashamed to be courteous and obey the rules of the road at all times.....	H	A	L	?
34.	that more powerful boat engines are not necessarily better.....	H	A	L	?
35.	an appreciation for all aspects of the marine environment, its value and the rationale for trade-offs in development versus preservation of the environment. We should help students to become informed voters and citizens, able to make decisions about the future of of the marine environment. Beyond that, we do not have the right to "teach" attitudes in endless trade-offs and compromises involving our marine resources and environment.....	agree		disagree	
36.	education should not create attitudes--that is called "brainwashing." Education shuld be directed toward creating a logical thought process and providing information to consider or the knowledge of how to find information.....	agree		disagree	

B. Our place in the ecosystem.

37. personal involvement (relationship) with the water....	H	A	L	?
38. that man is a part of the marine environment, not the owner.....	H	A	L	?
39. that water is absolutely necessary for our survival...	H	A	L	?
40. that man's survival is linked to the condition of the ocean and its resources.....	H	A	L	?

C. Stewardship.

41. protective of marine life.....	H	A	L	?
42. protective of spawning marine life.....	H	A	L	?
43. protective of endangered marine life.....	H	A	L	?
44. protective of the marine environment.....	H	A	L	?
45. protective of the Bay and surrounding waters.....	H	A	L	?
46. protective of endangered marine life.....	H	A	L	?
47. protective of marine food chains.....	H	A	L	?
48. protective of marine resources.....	H	A	L	?
49. protective of liveable conditions.....	H	A	L	?
50. protective of wetlands.....	H	A	L	?
51. protective of the ecological balance of the marine world.....	H	A	L	?
52. protective of clean water.....	H	A	L	?
53. a feeling of personal importance to the effort to preserve the marine environment for future generations.....	H	A	L	?
54. concerned if man should interfere with erosion and dunes.....	H	A	L	?
55. an abhorence of wasteful and careless destruction of the marine environment.....	H	A	L	?
56. that the marine environment is fragile and perhaps non-renewable.....	H	A	L	?
57. that the marine environment is a fertile area not to be used as a dump.....	H	A	L	?
58. that more salt grasses should be saved/planted to stop shoreline loss.....	H	A	L	?

D. Balance and priorities.

59. that there should be a balance between resource development and habitat preservation in the marine environment.....	H	A	L	?
60. an appreciation for the diversity of coastal users and the need for compromises between different interests.....	H	A	L	?
61. that there should be a balance between resource development and habitat preservation.....	H	A	L	?
62. that there should be a balance between aesthetics and economics.....	H	A	L	?
63. that there should be a balance between technology and the environment.....	H	A	L	?
64. willing to restrict certain developments if the resulting damage to the marine environment will be extensive.....	H	A	L	?
65. that exploitation of marine resources is not necessarily good or bad overall, but that the net benefits of each case must be considered for the long term.....	H	A	L	?
66. that there is more than one solution to a problem.....	H	A	L	?
67. a need to preserve the proper balance of nature.....	H	A	L	?
68. that there should be a balance between the future and immediate economic gain.....	H	A	L	?

E. Economics.

69. the importance of the Bay as an economic base.....	H	A	L	?
70. the importance of the Bay as a highway.....	H	A	L	?
71. the economic importance of marine resources.....	H	A	L	?
72. the economic importance of Virginia's marine industries.....	H	A	L	?
73. the economic importance of energy from the sea.....	H	A	L	?
74. the economic importance of marine life.....	H	A	L	?
75. the need to develop our marine resources.....	H	A	L	?
76. the need to improve marine industry.....	H	A	L	?

77. the need for the U.S. to have a merchant marine capable of satisifying a reasonable level of our countries needs..... H A L ?
78. that the marine environment should be used for making a living, not only for pleasure..... H A L ?

F. Seafood.
79. the importance of the seafood industry to our future..... H A L ?
80. the importance of maintaining resources for future fishermen..... H A L ?
81. that fishing (commercial and/or recreational) is a legitimate use of marine resources when effectively managed, and is not detrimental to the resource..... H A L ?

G. Environmental problems.
82. that unabated pollution of ocean and estuary is undesirable..... H A L ?
83. disgust and anger about blatant pollution such as Kepone..... H A L ?
84. anti-litter along coast as well as from boats..... H A L ?
85. that man is destroying the marine ecosystem by building, dredging, filling, etc..... H A L ?
86. the need to understand what can be dumped into the marine environment without causing unreasonable damage, and what cannot..... H A L ?
87. the need to maintain Virginia waters practically pollution free..... H A L ?
88. the need to avoid future pollution and reduce present pollution..... H A L ?
89. the need for anti-pollution measures..... H A L ?
90. an active interest in how to prevent such destructive forces as oil spills, chemical spills, etc..... H A L ?
91. that pollution of estuaries will ultimately destroy the marine environment..... H A L ?

H. Management.

92.	the need for resource management.....	H	A	L	?
93.	the need for more coastal zone management.....	H	A	L	?
94.	the need for enforcement of reasonable regulations, even if it costs.....	H	A	L	?
95.	laws to stop all pollution and erosion into the marine environment.....	H	A	L	?
96.	a positive frame of mind towards the Coast Guard and other regulatory agencies.....	H	A	L	?

I. Further study.

97.	a need to further understand and use marine resources.	H	A	L	?
98.	a need to develop more marine oriented programs in all our state schools from the primary grades to the graduate level.....	H	A	L	?
99.	the need for high school teachers to learn more marine ecology and appreciate its importance in the public school system.....	H	A	L	?
100.	the need for the state to provide scholarships to working teachers for marine studies.....	H	A	L	?
101.	a desire to learn more about the marine environment...	H	A	L	?

J. Aesthetics.

102.	love of the beauty of marine and estuarine environments.....	H	A	L	?
103.	love of marine life.....	H	A	L	?
104.	love of the part water plays in our environment and way of life.....	H	A	L	?
105.	a sense of beauty and harmony in the natural processes that occur in the marine environment.....	H	A	L	?
106.	an appreciation for marine art and literature.....	H	A	L	?
107.	that dunes and open beach are more appealing than rows of condominiums on the waterfront.....	H	A	L	?
108.	the uniqueness of Chesapeake Bay.....	H	A	L	?
109.	a need to visit a maritime museum.....	H	A	L	?
110.	a need to visit a U.S. port or merchant vessel.....	H	A	L	?

111.	a need to visit the Naval Museum, or a Navy ship.....	H	A	L	?
112.	that water can be the scene of "calm excitement" rather than simply a place for racing around in faster and faster boats.....	H	A	L	?

K. Marine Science.

113.	that marine science plays an important role in their everyday life.....	H	A	L	?
114.	that marine science is important for furthering knowledge of the marine environment and studying or monitoring its problems.....	H	A	L	?
115.	that marine science will contribute to national will being.....	H	A	L	?
116.	that marine science will result in an efficient selection of programs which will make possible the wise use of marine resources.....	H	A	L	?

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